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SITE MANAGEMENT PLAN

**SITE MANAGEMENT PLAN
NEAR SURFACE CONTAMINATION
CONSENT DECREE - REMEDIAL ACTION PLAN
SECTION 11**

QUALITY ASSURANCE BRANCH

JAN 7 1988

ENVIRONMENT SERVICES DIVISION

**Prepared for
The City of St. Louis Park
St. Louis Park, MN 55416**

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SITE MANAGEMENT PLAN

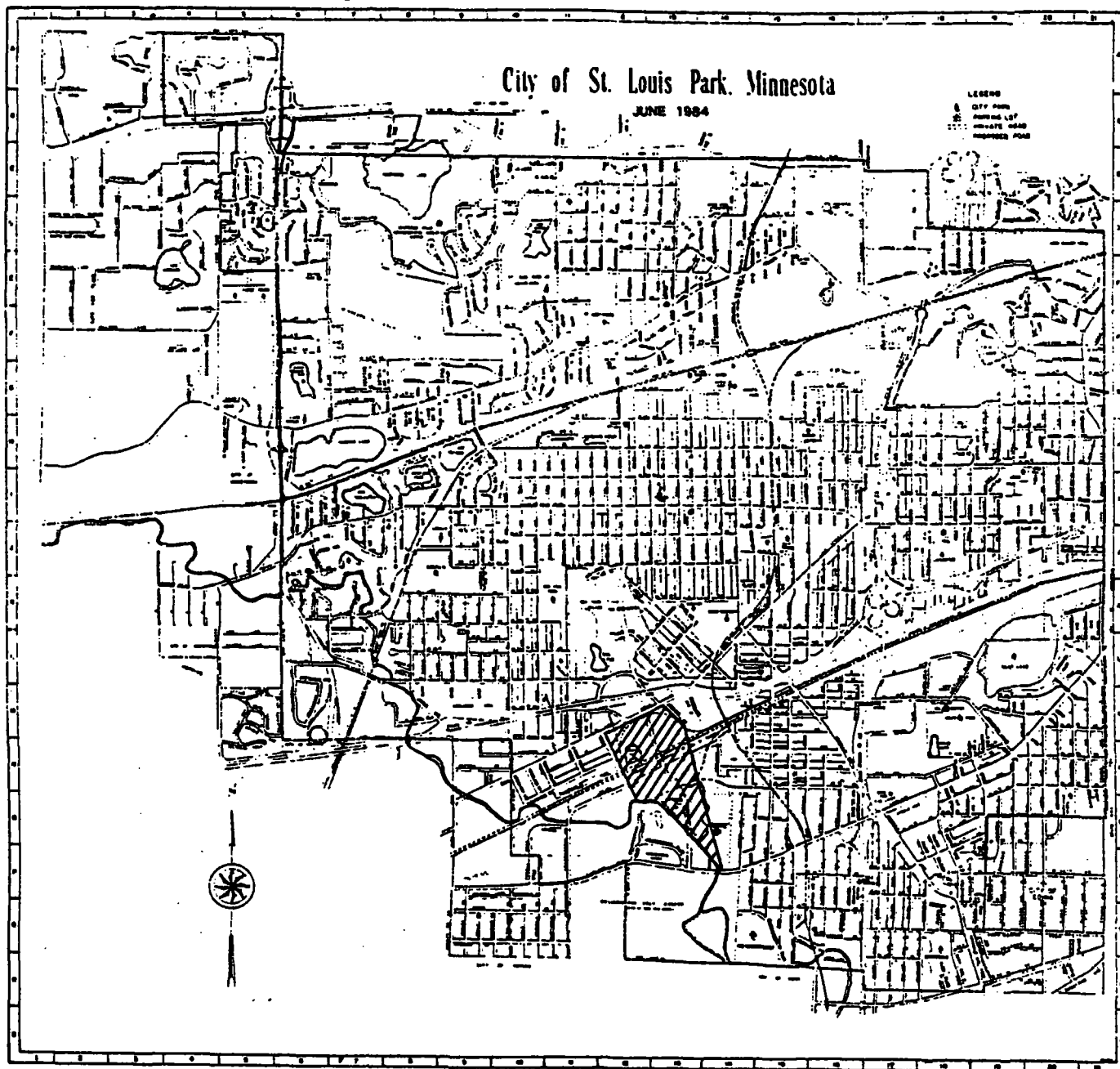
Site Background

The purpose of this Work Plan is to carry out a near-surface soils investigation on properties south of West Lake Street, east of Taft Avenue, west of Monitor Avenue and north of Minnehaha Creek (Figure 1). This investigation will be carried out in accordance with Section 11.1 of the CD-RAP. The goal of this soil investigation is to determine the areal extent of subsurface contamination south of the site that can be attributed to the activities of Reilly Tar & Chemical Corporation ("Reilly").

The area shown of Figure 1 constitutes approximately 300 acres of commercial-industrial property in St. Louis Park. Generally, the land slopes north to south toward Minnehaha Creek and contains numerous commercial and industrial building structures, parking lots, and streets. Most of the development that occurred in this area originated in the late 1940s and 1950s. Gordon Sash & Door Company and Cardinal Glass Company were a singular business during the 1960s. A division of these two businesses occurred in the early 1970s. Later, during 1979 and 1980, land was acquired and Louisiana Avenue was constructed between the two properties. Methodist Hospital occupies the largest land holding in the area of any of the properties. Established in 1948, the hospital corporation controls approximately 140 acres of property within the study area. Currently, four new land development operations are proceeding in the study area:

- 1) COSTCO is constructing a 10 acre commercial facility including building and parking lot in the open land area south of Cardinal Glass Company and east of Louisiana Avenue.
- 2) Mini-storage warehouses are proposed for approximately five acres of property south of Gordon Sash & Door Company west of Louisiana Avenue.
- 3) The City of St. Louis Park is proposing to enlarge the lined water storage pond south of West Lake Street and east of Taft Avenue next to the Flame Industries' properties. The new ponding area will project to the north from the current pond area and occupy an additional four acres of property.
- 4) Cardinal Glass Company has expanded its operations. Located south of West Lake Street and east of Louisiana Avenue, approximately 50% more warehouse space has been added to the original structure.

These projects are significant in that approximately 20 acres or more of open land will soon be covered with impermeable materials.



Site Hydrogeology

Numerous soil borings have been made in the site area for various purposes. The logs for many of these borings are contained in Appendix A. These boring logs indicate the drift is a complex arrangement of till, sand and gravel, clay and silt, and organic soils such as peat and muck. Figure 2, presents a generalized stratigraphic column of the glacial soils expected to be encountered during drilling at the site. The uppermost bedrock unit is the Platteville Formation, except in areas where bedrock valleys exist into the St. Peter Sandstone (Figure 3). The depth of bedrock is generally 60 to 70 feet except in the bedrock valleys where the depth may exceed 100 feet.

Groundwater is generally encountered within five to ten feet of the ground surface throughout the site. Before much of the site was developed, the site was largely a peat bog, with many ponds that were surface water expressions of the groundwater table. Groundwater flow is generally to the east as shown in Figures 4 and 5.

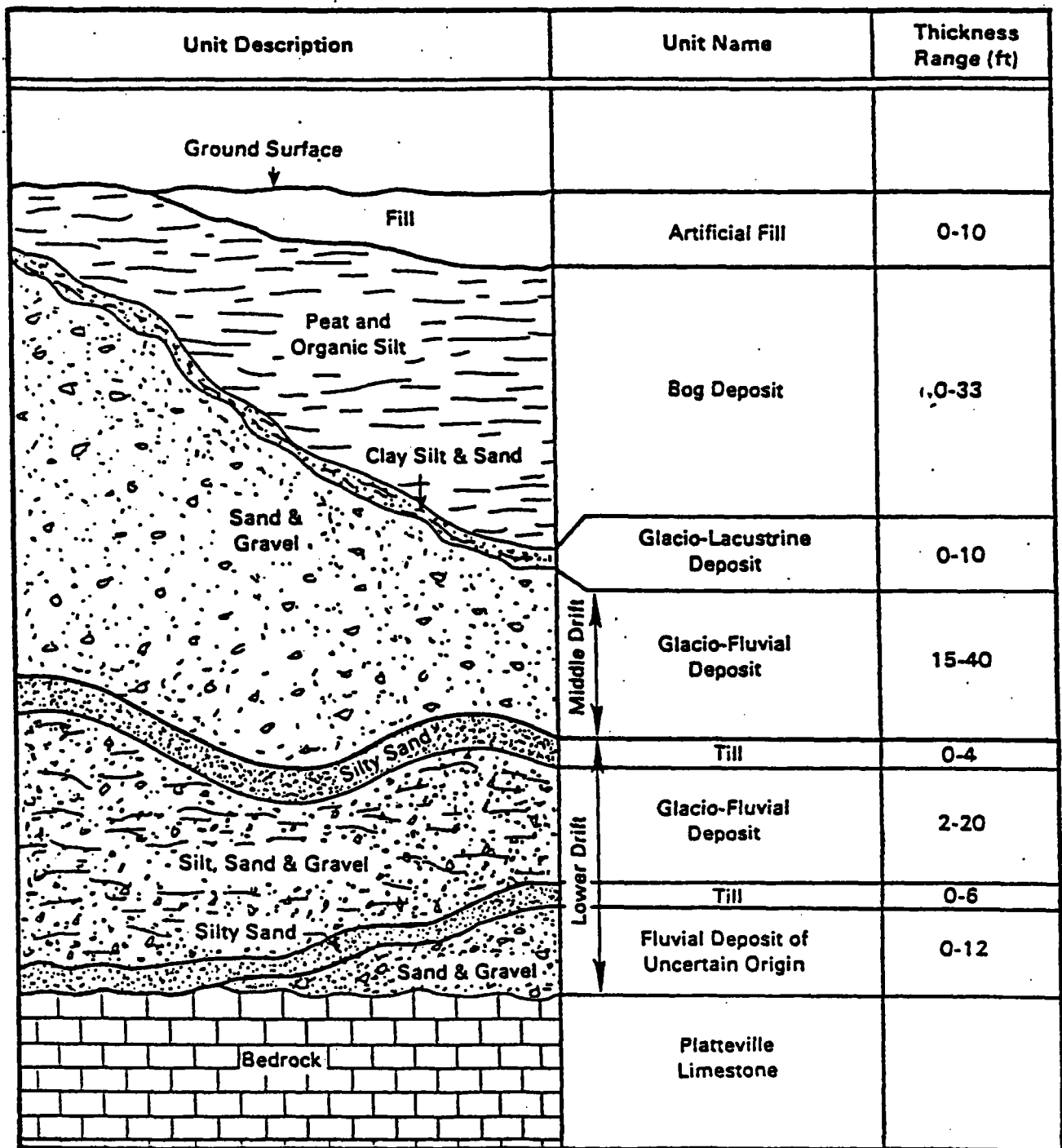
During the years of operation of the Reilly (Republic Creosote) coal tar refinery and wood preserving plant in St. Louis Park, site drainage was in a southward direction. Contaminants originating from drips, leaks, and spills at the Reilly Site were carried with the overland drainage and entered the wetland area south of Walker Street and north of West Lake Street. From these wetland areas, much of the runoff percolated into the substrata causing subsurface contamination. Some of the surface drainage continued through the wetland area to the south to the study area.

Nature of the Problem

Previous information gathered for evaluation of soils in the area is summarized in Figure 6 and more completely contained in Appendix A. Most of the soil boring projects were done for engineering evaluations of soil conditions; few commented on the occurrences of contamination in the soil samples. However, there were visual and olfactory observations made to the extent that the absence of or presence of contamination can be estimated. Other soil boring projects were done specifically for environmental investigations. Barr Engineering Company looked for and found no evidence of contamination in their boring number 6 in this area (see Figure 6). Additionally, six borings were taken in 1979 along the present route of Louisiana Avenue to ascertain if soil contamination was present. Analysis of phenolics and benzene extractables were made of 42 soil samples at the time. All six borings were qualitatively described as contaminated and/or contained elevated concentrations of phenolics and/or benzene extractables.

Boundaries

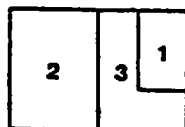
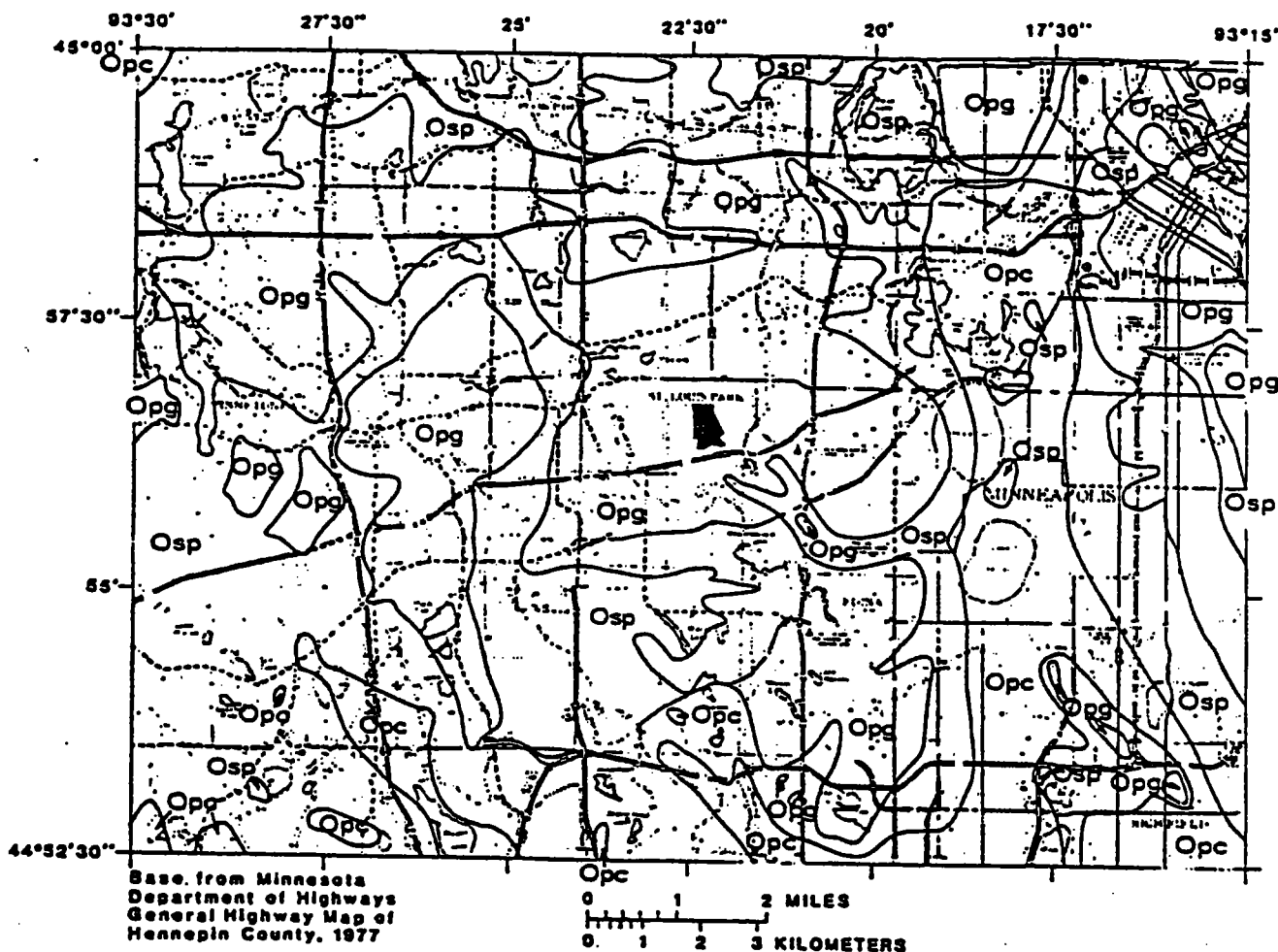
The site map enclosed with this work plan (Exhibit A) delineates the properties included in the study area. Based on Section 11.1 of the CD-RAP the site boundaries have been set based on property lines following the area bounded by Lake Street on the north; Monitor Street and an imaginary straight-line extension of Monitor Street to Methodist Hospital on the east; Minnehaha Creek on the south; and Taft Avenue and an imaginary straight-line extension of Taft Avenue to Minnehaha Creek on the west (Figure 1).



Thickness, morphology and position of geologic units are based on boring information. This column represents a variety of conditions that may be encountered beneath the site; it may not depict all possible conditions.

FIGURE 2 Generalized Surficial Geologic Column

(ERT, 1983)



1. Modified from Norvitch, R. F., and Walton, M. S., 1979, U. S. Geological Survey Miscellaneous Investigations Map I-1157
2. Modified from Minnesota Geological Survey, Unpublished Map
3. This study

INDEX TO GEOLOGIC MAPPING

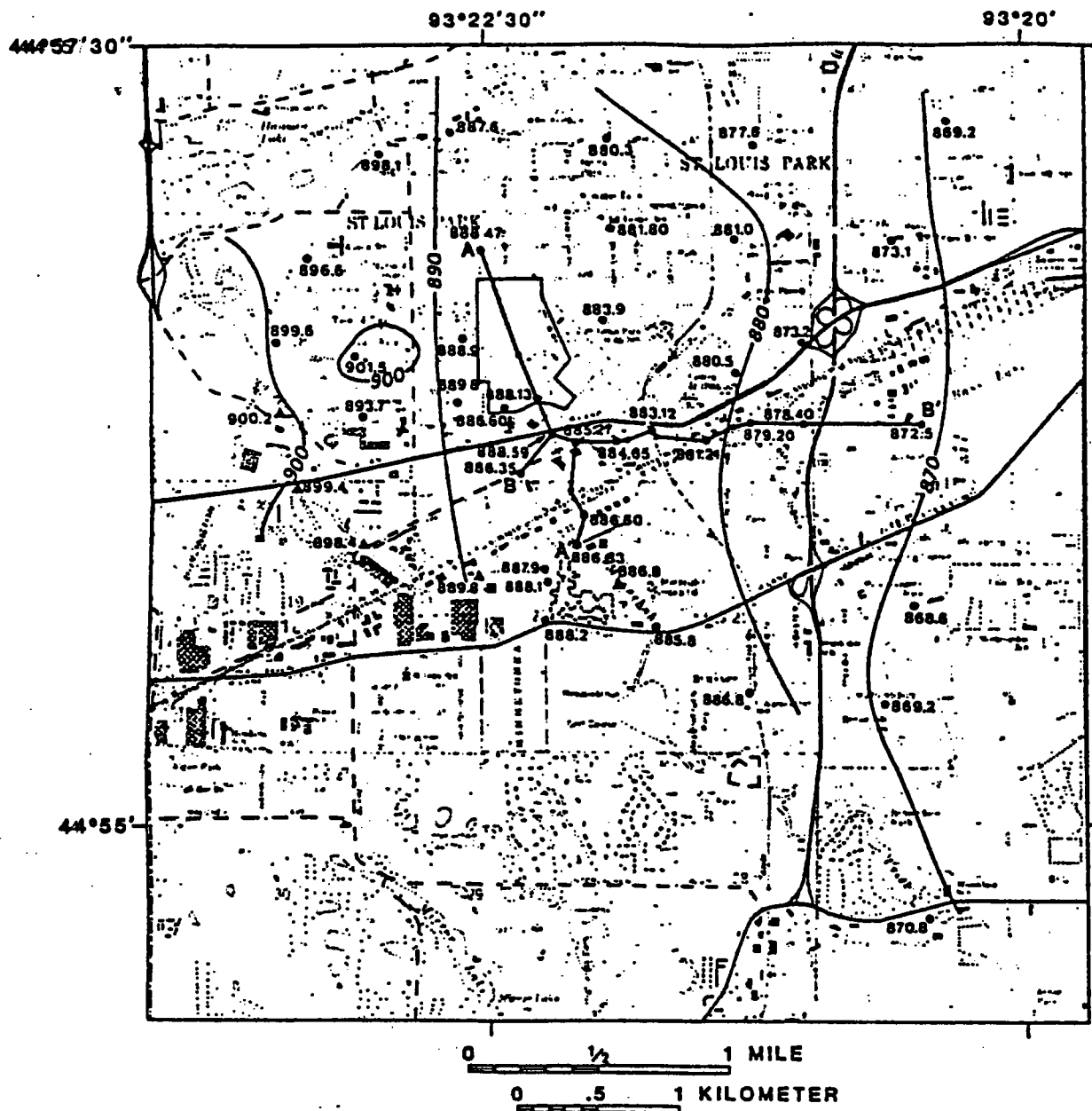
EXPLANATION

CORRELATION OF MAP UNITS

- | | | |
|------------|--|--------------|
| Opg | Platteville and Glenwood Formations, undivided | } ORDOVICIAN |
| Osp | St. Peter Sandstone | |
| Opc | Prairie du Chien Group | |

- Approximate geologic contact
- Site of former plant

FIGURE 3 Preliminary Bedrock Geology (From USGS Water Supply Paper 2211)



EXPLANATION

Water-level altitude, in feet above sea level. Number of significant figures indicates reliability of measuring point altitude. (See text)

886.35₂ Water-table piezometer and water-level altitude

898.4₁ Surface-water station and water-level altitude

—880—

B — B'

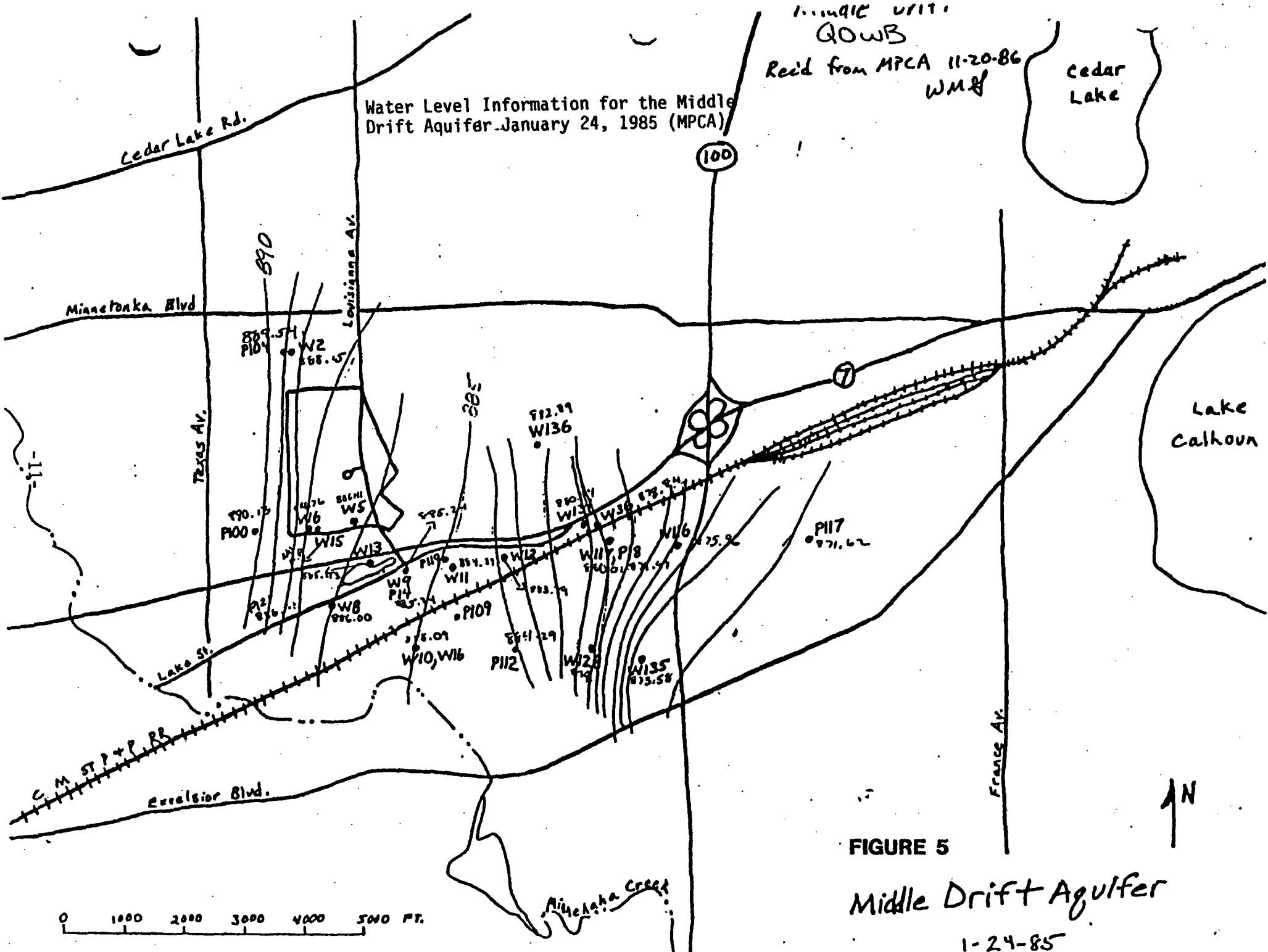


WATER-TABLE CONTOUR--
Shows altitude of water table. Contour interval 10 feet. Datum is sea level

Line of section (plate 3)

Site of former plant

FIGURE 4 Generalized configuration of the water table, June 5, 1979 (WSP 2211)



Water Level Information for the Middle
Drift Aquifer January 24, 1985 (MPCA)

1. MPCA UNIT
QOWB
Rec'd from MPCA 11-20-86
WMB

Cedar
Lake

Lake
Calhoun

FIGURE 5

Middle Drift Aquifer

1-24-85

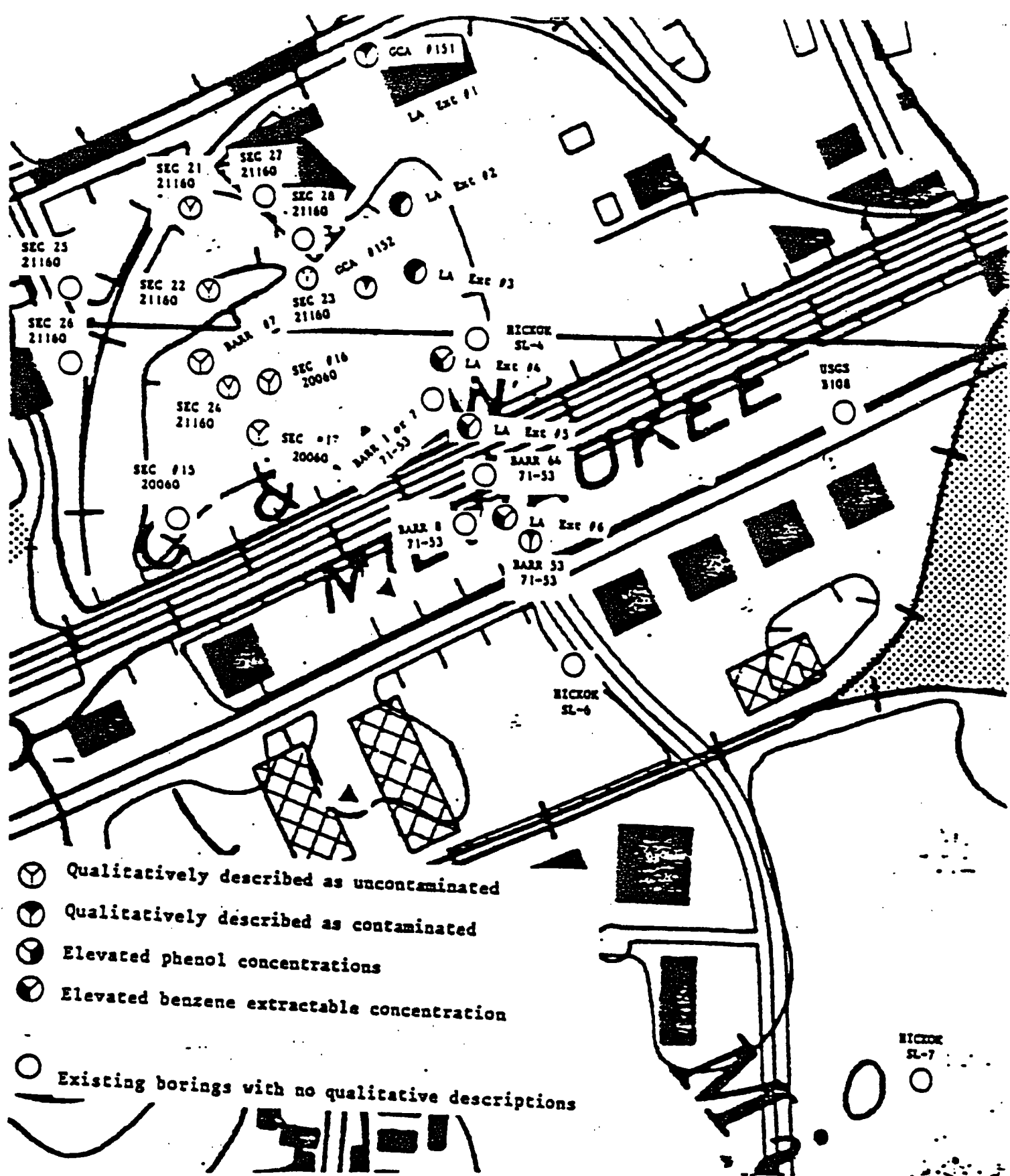


FIGURE 6 Locations of Existing and Proposed Borings in the Area of Soil Investigation*.

*Boring locations from document number 413872

Soil Sampling Plan

This Work Plan specifies the location and design of the soil borings and conduct of the soil sampling procedure. Exhibit A shows the proposed location of 15 soil borings, which shall be drilled to a depth specified by the City's representative based upon field observations and the depth parameters stated in CD-RAP. Insofar as the CD-RAP requires at least 15, but no more than 25, soil borings be drilled, the City has chosen to utilize information generated from the drilling of the 15 borings to develop a pattern of contamination which can be confirmed or clarified by the drilling of an additional 10 borings. The USEPA and MPCA shall have final approval over soil boring locations after consideration of the City's recommendations. The Agencies have acknowledged the need to quickly approve any additional borings that may be recommended while the drilling equipment is on site.

Drilling activities must be completed within 90 days of receipt of approval of this Plan, however, in the event the Agencies and Reilly and the City agree it is in the best interests of the parties to undertake the work during weather conditions which permit the effective use of the sense of smell, an amended completion schedule shall be established.

The CD-RAP requires soil borings be drilled to a depth of at least 35 feet, but no deeper than the top of the Platteville Formation. Soil boring logs will be recorded for each soil boring and a portable organic vapor detector/analyzer will be used to supplement qualitative descriptions of soil samples. All readings from the device will be recorded on the boring logs.

The CD-RAP further requires that at least 15, but no more than 45, soil cores be selected for analysis of benzene extractables and/or phenolics based upon visual and/or olfactory evidence of contamination. Although numerous samples will be retrieved in duplicate for the purpose of confirming soil description, the City's representative shall be responsible for designating the 15 to 45 samples to be analyzed pursuant to the requirements of the CD-RAP. The duplicate samples will be evaluated in an environmentally controlled (heated and vented) area by the logging geologist for the presence of odors related to coal tar/creosote materials.

An important consideration pertaining to this soil investigation is the definition of contamination. Although the CD-RAP defines surface and groundwater quality criteria for PAH and phenolics, no such criteria are specified for phenolics or benzene extractables in soil. With the objective being to locate areas where a release of hazardous substances resulting from Reilly's former operation is occurring or has occurred it is critical to relate the data being generated in this study to such a determination.

The CD-RAP defines Contamination as "PAH and Phenolics resulting from activities of Reilly at the (former coal tar refinery and wood treating) Site when found in the groundwater or the soil." The first criterion that will be used to define contamination is visual observation. This qualitative criteria is appropriate because the type of contaminants associated with Reilly's activities often produce a dark stain or discoloration of the soil. The presence of odors and organic vapors detected with the organic vapor detector/analyzer will supplement the visual descriptions of contamination.

The second criterion for determining the presence of contaminated soils will be based on the benzene extractables and phenolics data being generated in this investigation. Two factors must be considered: First, the analysis for benzene extractables must be considered an appropriate indicator of PAH originating from Reilly's activities. This is agreed to be an appropriate analytical method because it now appears in the negotiated CD-RAP settlement. Second, it must be recognized that the analytical methods that will be utilized for this investigation will detect all benzene extractables and phenolics in the samples, including some that did not result from Reilly's activities. The issue of background concentrations of benzene extractables and phenolics has been examined in detail in a previous study (ERT, 1983). That study contained the following discussion:

A sample of soil is deemed contaminated if it contains concentrations of indicator compounds that exceed background concentrations typical for the type of soil from which the sample was taken. It is important to emphasize that all types of soil in the site area contain some background concentration of phenolics and benzene extractable hydrocarbons (see tables 1 and 2). These background concentrations originate from anthropogenic as well as natural sources. The anthropogenic sources result from off-site activities that were not in any manner related to the former manufacturing operations of Reilly Tar & Chemical Corporation, and they also proportionately result from former Reilly Tar & Chemical Corporation manufacturing operations. For example, anthropogenic sources of benzene extractable hydrocarbon background concentration can result from combustion products of fossil fuels, spills of fossil fuels and bituminous concrete pavement. The steady manufacture, use and disposal of various common commercial products, especially in industrial/commercial areas, result in at least low level accumulations of chemicals that exceed naturally occurring background concentrations. This increase represents the anthropogenic contribution to background concentrations.

There are only two background soil samples taken from near the site area that have been analyzed for benzene extractable hydrocarbons. A benzene extractable hydrocarbon concentration of 22,300 milligrams per kilogram was obtained from a sample described as peat that was taken in March, 1978 by Soil Exploration Company near the Westwood Townhouses which are located two miles northwest of the site. The other sample was described as "sandy soil", and it produced a benzene extractable hydrocarbon concentration of 200 milligrams per kilogram. The "sandy soil" location is given by Soil Exploration Company as "Roseville Soil" and the collection date was November, 1978.

In light of the lack of definitive background data, estimates of background concentrations were formulated. These estimates were based upon comparing quantitative measurements of phenolics and benzene extractable hydrocarbons to qualitative descriptions of contamination in the soil samples for each soil type. Table B3-1 is a summary of the data base used in this evaluation, and Table B3-2 presents the estimated background levels.

Dependence upon the qualitative descriptions of certain soil samples as being visibly contaminated introduces an unknown and unavoidable level of subjectivity in this analysis. The data in Tables 1 and 2 are considered sufficient, however, for identifying approximate background concentrations for the various soil types. For example, a benzene extractable hydrocarbon concentration of 20,000 milligrams per kilogram is a typical background concentration for the peat underlying the Site, but it would indicate distinct contamination of the glacio-lacustrine clay which has a benzene extractable hydrocarbon, background concentration of 1000 milligrams per kilogram.

For this study, background levels of benzene extractable hydrocarbons will be determined by testing a maximum of 10 samples classified by the sense of smell as "clean". These samples will be tested in the laboratory to further determine benzene extractable hydrocarbon levels and classified as ostensibly uncontaminated soils. Of these samples, several should be composed of peat, with a less number of till, lacustrine and glaciofluvial sediments.

If a sample of soil has appreciable discoloration or smells of creosote, it will be defined as contaminated for the purposes of this investigation. Instrument readings of the portable organic vapor detector and BEH data are for confirmation and indicators of relative contamination.

Notices in Deed

Upon completion of the soil boring and testing program, the City shall coordinate an effort to notify the Parties to the CD-RAP owning property in the study area of the soils investigation. Parties owning property in the study area on which a release of hazardous substances resulting from operations at the Site has occurred or is occurring based on earlier limits identified in the report shall file an affidavit with the Recorder of Deeds of Hennepin County which complies with Minnesota Statute 115B.16, Subdivision 2 (1984). The City will facilitate this work effort. Also, within 180 days of completing the soil boring program the City will submit a list of owners and locations of other properties on or under which a release has occurred or is continuing to occur.

Drilling Procedures

A licensed water well contractor or geotechnical engineering firm with a licensed monitor well engineer will be hired for all drilling activities associated with this investigation. The contractor will follow the Minnesota Water Well Construction Code.

All field equipment and sampling tools will be steam cleaned prior to the mobilization to the site and between each borehole. All boreholes will be drilled using either truck mounted or all-terrain vehicle mounted auger/rotary type drill rigs utilizing continuous hollow stem flight auger casing in the upper levels of the borehole. Soil samples will be collected in accordance with the sample collection and preservation procedures to be discussed in a later section. The geologist on the drill team will take possession of all soil samples for preparation immediately upon retrieval from the borehole.

TABLE 1

DATA BASE SUMMARY FOR SOIL QUALITY EVALUATION (ERT, 1983)

Date Range ⁽¹⁾	Artificial Fill		Bog Deposit		Glacio-Lacustrine Deposit		Middle Drift		Lower Drift	
	Total	No. Visibly	Total	No. Visibly	Total	No. Visibly	Total	No. Visibly	Total	No. Visibly
	No. ⁽²⁾	Contam. ⁽³⁾	No.	Contam.	No.	Contam.	No.	Contam.	No.	Contam.
P<0.2	-	-	-	-	-	-	7	-	11	-
0.2<P<0.5	1	-	1	-	1	-	21	-	14	-
0.5<P<1.0	2	1	4	2	7	-	16	1	14	-
1.0<P<2.0	1	-	1	-	5	2	8	1	-	-
2.0<P<5.0	3	3	2	-	-	-	8	3	6	-
5.0<P<10.0	1	1	1	-	3	3	4	3	1	-
10.0<P<20.0	1	1	1	-	3	2	1	1	-	-
20.0<P<50.0	1	1	5	4	-	-	-	-	-	-
P>50	-	-	6	5	-	-	-	-	-	-
B<50	-	-	-	-	-	-	5	-	11	-
50<B<100	-	-	-	-	2	-	14	-	19	-
100<B<200	-	-	-	-	6	1	17	1	22	-
200<B<500	3	-	-	-	1	-	12	-	-	-
500<B<1,000	2	1	1	-	1	-	1	1	3	-
1,000<B<2,000	1	1	1	1	1	1	5	4	2	-
2,000<B<5,000	1	1	3	-	4	1	3	1	-	-
5,000<B<10,000	-	-	3	1	1	1	1	-	-	-
10,000<B<15,000	1	1	4	1	3	2	1	1	-	-
15,000<B<20,000	1	1	2	2	1	1	1	1	-	-
20,000<B<25,000	-	-	3	1	-	-	-	-	-	-
B>25,000	2	2	6	6	-	-	-	-	-	-

(1) Data range in milligrams per kilogram for phenolics (P) and benzene extractable hydrocarbons (B).

(2) Total number of samples from Barr (1976) and Soil Exploration Company (1978).

(3) Number of samples described in Barr (1976) as visibly contaminated.

TABLE 2

ESTIMATED BACKGROUND CONCENTRATIONS OF PHENOLICS AND BENZENE EXTRACTABLE HYDROCARBONS (ERT, 1983)

Soil Type	Background Level Milligrams per Kilogram		Comments	
	Phenolics	Benzene Extractable Hydrocarbons	Phenolics	Benzene Extractable Hydrocarbons
Fill	1	500 - 1,000	7 of 8 samples ≥ 1 milligram per kilogram described as visibly contaminated.	1 of 4 samples < 1000 milligrams per kilogram described as contaminated. All 6 samples > 1000 milligrams per kilogram described as contaminated.
Peat and Organic Silt (Bog Deposits)	10	10,000 - 25,000	2 of 9 samples < 10 milligrams per kilogram described as contaminated. 9 of 12 samples > 10 milligrams per kilogram described as contaminated.	2 of 8 samples $< 10,000$ milligrams per kilogram described as contaminated. All six samples $> 25,000$ milligrams per kilogram contaminated. One background sample at 22,300 milligrams per kilogram.
Clay & Silt (Glacio-Lacustrine Deposits)	5	1,000	2 of 13 samples < 5 milligrams per kilogram said to be contaminated. 5 of 6 samples > 5 milligrams per kilogram said to be contaminated.	1 of 7 samples less than 1,000 milligrams per kilogram described as contaminated. 7 of 10 samples $> 1,000$ milligrams per kilogram said to be contaminated.
Sand & Gravel (Glacio-Fluvial Deposits)	1 - 2	1,000	1 of 44 samples < 1 milligram per kilogram described as contaminated. 7 of 13 samples > 2 milligrams per kilogram described as contaminated.	2 of 52 samples $\leq 1,000$ milligrams per kilogram said to be contaminated. 7 of 11 samples $> 1,000$ milligrams per kilogram described as contaminated.
Clay, Silt, Sand & Gravel (Indifferentiated Till and Glacio-Fluvial Deposits)	1	500	None called contaminated. 39 of 46 samples were ≤ 1.0 milligram per kilogram. Maximum value was 7.8 milligrams per kilogram.	None called contaminated. 52 of 57 samples were ≤ 500 milligrams per kilogram. Maximum value was 1,900 milligrams per kilogram.

It is anticipated that various soil types will be encountered in the borings. Individual samples will not be composited for analytical testing. Soil types from different strata will not be mixed, maintaining the integrity of each different soil type which may possess its own individual chemical characteristics. Below the groundwater level, bentonite based drilling fluid mixed with water will be introduced to the borehole to maintain the stability of the borehole sides and prevent the native soils from entering into the casing in a disturbed manner. Samples of the water used for mixing the drilling fluid and the drilling fluid additive will be tested for chemical constituents as well.

Below the water table, to prevent the drilling fluid from entering into the sample, a specific sampling procedure will be followed. This procedure will involve the complete encapsulation of the entire split-spoon and lower 6 inches of drill rod into a thin plastic or latex membrane, sealed above the split-spoon with a rubber binder. Upon completion of each soil boring, the boring will be completely grouted by pumping a mixture of cement and bentonite to the bottom of the borehole using a tremie pipe until undiluted grout is seen at the surface, in accordance with Minnesota Department of Health Well Construction Code requirements. Also cuttings will be containerized for later disposal according to applicable regulations.

Between each boring location, the drilling and sampling tools, as well as the drill rig, will be steam cleaned at the City Public Works garage 7305 Oxford Street to minimize the possibility of cross contamination at boring locations. The wash water and any soil cuttings will be placed in the sanitary sewer or will be collected in a 55 gallon drum for disposal according to applicable regulations whichever is applicable.

Soil Sampling Procedures

Soil samples, weighing at least 200 grams, will be obtained using the split-barrel sampling procedure in general conformance with ASTM Specification D-1586-84. The geologist will classify the samples in accordance with ASTM D-2488-84, and the soil samples will be placed in 500 ml wide mouth clear glass sample containers fitted with aluminum foil lined caps. Duplicate samples for chemical analysis will be collected at the rate of one in 20 samples. Duplicate samples will be collected by splitting the sample longitudinally with a stainless steel knife, and placing each half in separate sample jars. All samples will be then stored at 4°C for transportation to the analytical laboratory. Chain of custody forms will be maintained for all soil samples obtained.

A new pair of disposable latex gloves will be used for each sampling site. Between sites, and between each use of the split-barrel sampler, sampling equipment will be steam cleaned and rinsed with acetone, hexane, acetone, and then deionized water prior to reuse.

Phenolic and Benzene Extractable Analyses

The level of phenolic material in each soil sample will be measured on a 3 to 5 gram soil sample using the Distillation Chlorogrom Extraction procedure contained on pages 556 through 560 of Standard Methods for the Examination of Water and Wastewater, 16th Edition (EPA 420.1). The detection limit of this phenolic analysis procedure is approximately 0.2 mg/kg (wet weight) when applied to soil samples. Benzene extractable material will be measured by extracting a 20 gram soil sample with benzene in a Soxhlet extraction apparatus for four hours and measuring the total weight of material extracted. Except for the use of benzene as the solvent, the analytical procedure used to measure the concentration of extractable material is the same as the Soxhlet extraction procedure given on page 499 of Standard Methods for the Examination of Waste and Wastewaters, 16th Edition (Park 502D). Extracted material is reported in milligrams of extracted material per kilogram of sample, (The detection limit for the benzene extractable analyses is 50 mg/kg - wet weight).

To measure the concentration of phenolic material and benzene extractable material, a 100 gram sub-sample will be taken from each soil sample and quartered to obtain a 25 gram sample. Twenty grams of the quartered subsample will be used in the analysis for benzene extractable material and 3 to 5 grams of the quartered sub-sample will be used in the analysis for phenolic material. To obtain the moisture content and, therefore, the dry weight of the soil sample, a quarter of the sub-sample will be oven dried at 105 degrees centigrade to a constant weight. To document reproducibility of data for the benzene extractable and phenolic analyses when the analyses are applied to soil samples from the study area, duplicate analyses will be conducted on 5 percent of the submitted samples.

Report

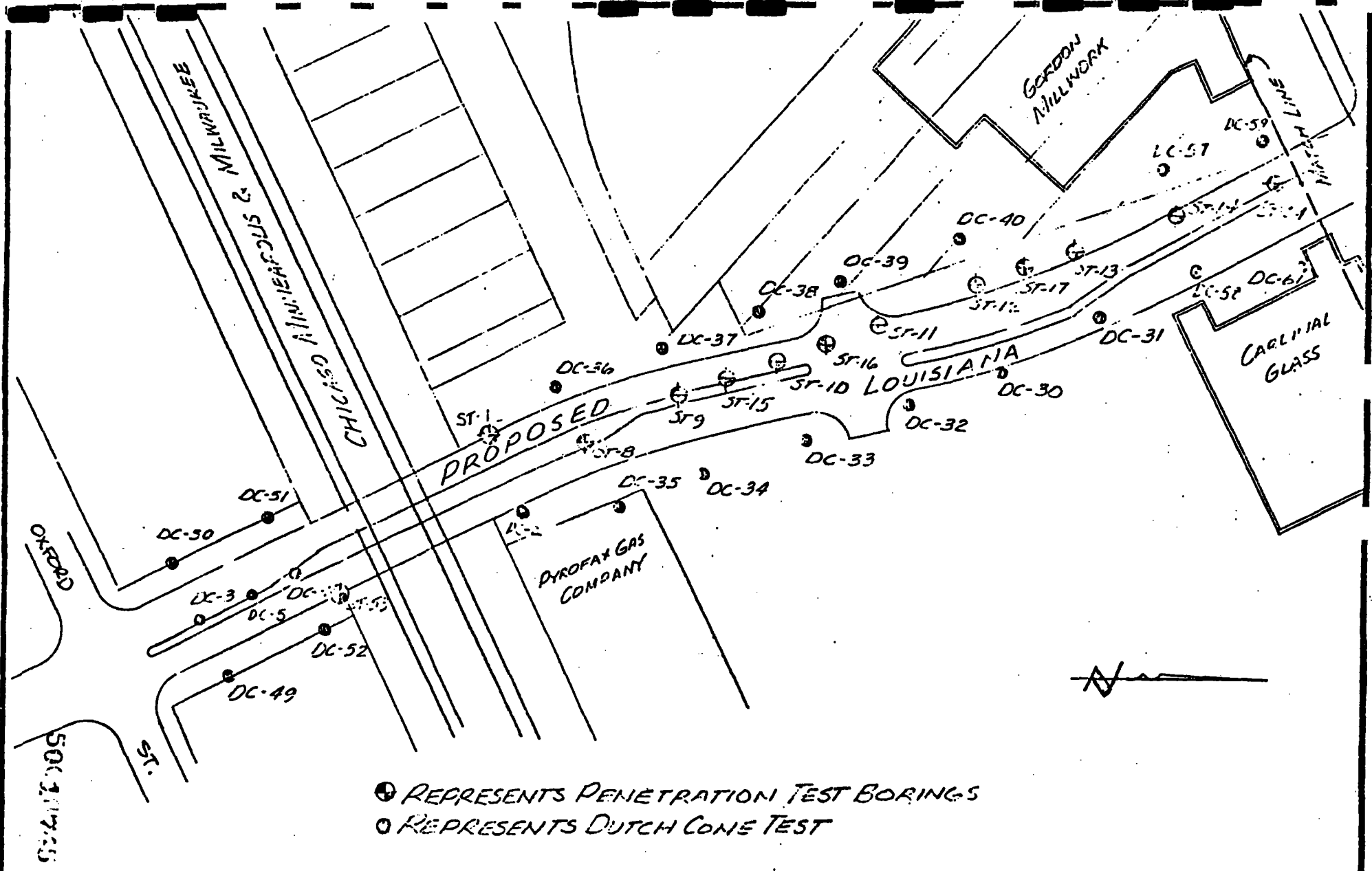
A report will be prepared to compare and briefly evaluate the results of the soil investigation work effort; an analysis of probable surficial flow path(s) from the site to Minnehaha Creek; and an estimate of the relative hazard of the contaminated soils remaining. All data generated during the investigation will be reported including, but not limited to, a map of the area investigated, the location of the boring, boring logs, analytical results, and visual and/or olfactory observations. Additionally, summary tables and figures will be prepared to support a discussion of the observed extent and magnitude of contamination.

APPENDIX "A"

BRAUN REPORT

Project No. 71-53

April 14, 1975

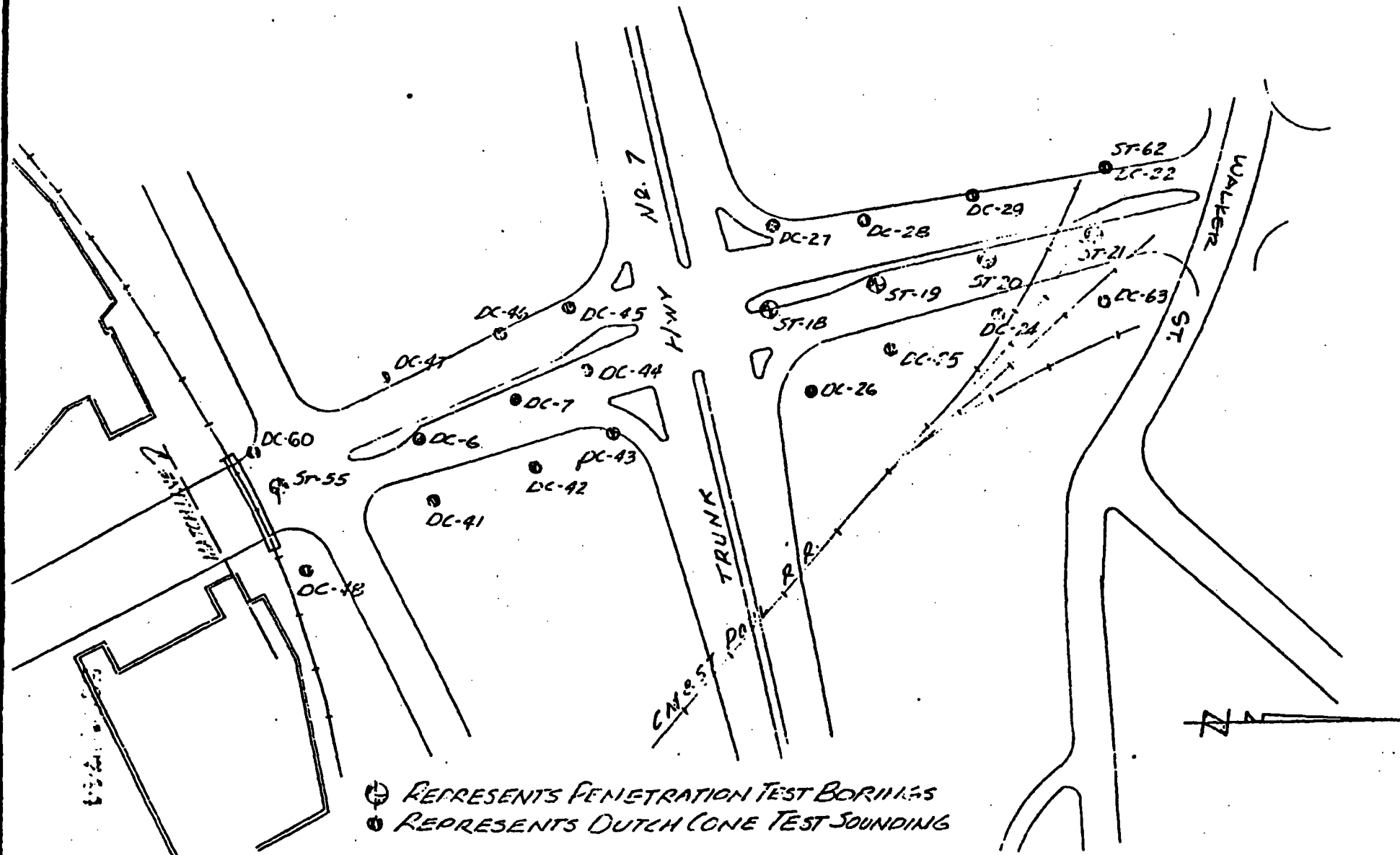


● REPRESENTS PENETRATION TEST BORINGS
 ○ REPRESENTS DUTCH CONE TEST

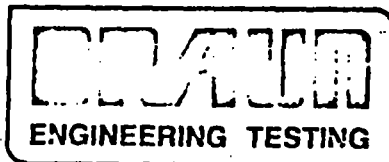


71-53 SOIL BORINGS FOR:
 PROPOSED LOUISIANA AVENUE EXTENSION
 ST. LOUIS PARK, MINN.

Date:	3/20/75
Revised:	
Drawn:	GLN
Scale:	1" = 125'



⊙ REPRESENTS PENETRATION TEST BORINGS
 ● REPRESENTS DUTCH CONE TEST SOUNDING



71-53 SOIL BORINGS FOR:
 PROPOSED LOUISIANA AVENUE EXTENSION
 ST. LOUIS PARK, MINN

Date: 3/20/15
 Revised:
 Drawn: GLN
 Scale: 1" = 125'

ENGINEERING TESTING

BORING: ST-1

LOCATION:

63' North of Northwest Corner
of proposed bridge abutment.

DATE: 2/4/75

SCALE: 1"=5'

Blow.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
	0					Page 1 of 3
		SM- SC	FILL, SILTY CLAYEY SAND, with some concrete chunks, dark brown, frozen to moist, hard to soft	57		Penetration resistance at the 3' depth is not representative due to the frozen soil condition.
	6			2		
		PT	PEAT, organic, fibrous, black to dark brown, moist to wet, (Swamp Deposit)	2		
				2		
	13			2		
		PT	MUCK, organic, with a trace of shells, dark olive brown, moist to wet, (Swamp Deposit)	2		
				2		
				3		
				2		
	34					
		SP	SAND, with a trace of gravel, gray, waterbearing, loose, (Glacial Outwash)	5		Sample depth-29'-30' OC = 33.4% MC = 205.5%

(Continued on following page)

LOG OF BORING



PROJECT: 71-53 SOIL BORINGS
Louisiana Avenue Extension
St. Louis Park, MN

BORING: ST-1 (continued)

LOCATION:

DATE: 2/5/75

SCALE: 1"=5'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
	35					Page 2 of 3
		SP	SAND, with a trace of gravel, gray, waterbearing, loose, (Glacial Outwash)			
				9		
				9		
	49					
		CL	SILTY SANDY CLAY, with some gravel, gray, wet, stiff to very stiff, (Glacial Till)	15		
				22		
	58					
		SP	SAND, with some gravel, : gray, waterbearing, medium dense, (Glacial Outwash)	14		
				16		
	70			17		

(continued on following page)

500107-17

LOG OF BORING

ENGINEERING TESTING

PROJECT: 71-53 SOIL BORINGS
Louisiana Avenue Extension
St. Louis Park, MN

BORING: ST-1 (continued)

LOCATION:

DATE: 2/5/75

SCALE: 1"=5'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2483)	BPF	WL	Tests or Notes
	70					Page 3 of 3
	77	SP	SAND, with some gravel, gray, waterbearing, medium dense. (Glacial Outwash)	9		
	84	SP- SM	SAND, slightly SILTY, fine to medium grained, reddish brown, waterbearing. (Alluvium)	14		
	87		SHALY SANDSTONE, greenish, (Glenwood Formation)	42		
	95		SANDSTONE, light brown, (St. Peter Formation)	150		Blows in 5"
			Boring terminated due to refusal in the St. Peter Sandstone Formation. Water level down 13' 15 minutes after completion of boring.	100		Blows in 2"

5001 1748

(See report and standard plates for evaluation and descriptive terminology.)

LOG OF BORING



PROJECT: 71-33 Soil Borings
Louisiana Avenue Extension
St. Louis Park, Minnesota

LOCATION: Sta. 6+00, centerline

Elev.	Depth	ASTM D2487	Description of Materials (ASTM: D2488)	PF	Notes
180.6		SC	FILL, SILTY CLAYEY SAND, dark brown to brown, frozen to moist		
177.6	3	SC			
176.1	4.5	SC	FILL, CLAYEY SAND, brown moist soft *		
	6.5	PT	PEAT, dark brown, fibrous, moist, Swm n		
170.6	10	SM	SILTY SAND, some gravel, greenish brown, moist, very dense, (Glacial Till)		
167.6	13	SC	YEY SAND, th some gravel, ay, moist, very stiff, lacial Till		
164.6	16	SM- SC	ILTY CLAYEY SAND, th some gravel, ark gray, slight chemical smell, t ver rif	17	
161.6		SP	th a trace of gravel, ray, wet, tiff,		
		SC- SM	ILTY CLAYEY SAND, th a trace of gravel, ay, wet, tiff, (Glacial Till)	16	
	25.5		ater level down 8' 15minutes after ompletion of boring. th seam of whitish gray SILTY Y at 4.5'.	15	

50010753

LOG OF BORING

BRADON
ENGINEERING

PROJECT: 71-53 SOIL BORINGS
Louisiana Avenue Extension
St. Louis Park, MN

LOCATION:
Station 8 + 00
6' Left of Centerline

DATE 2/17/75 CASE 1"-5'

Elev.	ASTM D2487 Symbol	Description of Materials ASTM D-2488	Tests	Gr
176.4	SM-SC	FILL, SILTY SAND-CLAYEY SAND, with a trace of gravel, brown, frozen to moist, loose		
172.4	PT	PEAT, fibrous, dark brown to black, stiff, (Swamp Deposit)		
	SP-SM	lightly silty, with a trace of gravel, gray, terebearing, medium dense, (Glacial Outwash)	14	
			22	
156.9	SP	with some gravel, dark gray, terebearing, medium dense, (Glacial Outwash)		
		CLAY,*		
		water level down 9' 15 minutes after completion of boring.		
		with a trace of gravel, gray, very stiff, medium dense, (Glacial Till)		

and Standard Plates for evaluation and description of terminations

BRAUN
ENGINEERING TESTING

SS-13

LOCATION:
Station 10 + 00
4' Left of Centerline

A . 2/17/75 . 1"=5'

Tests or Notes

ASTM
D2487
bol

SM-SC

4.5

ML

PT

MI

CLAYEY SILT.
sl. bluish
very fine

SE

SAND,
fine to medium grained,
with a trace of gravel,
gray,
waterbearing,
loose to medium dense,
(Glacial Outwash)

19

Water level down 9' 15 minutes af er
completion of boring.
Boring immediately backfilled.
*with small chips,
white,
wat

LOG OF BORING



PROJECT: 71-53 Soil Borings
Louisiana Avenue Extension
St. Louis Park, Minnesota

ST-17
LOCATION: Sta. 9+50, 6' Left
of centerline

DATE: 2/18/75 **CALE:** 1"-5

Elev.	ASTM D2487	Description of Materials (ASTM: D2488)	PT	Tests or Notes	
				Tests	Notes
175.5	SC	FILL, SILTY CLAYEY SAND, with a trace of gravel, brown to dark gray, frozen to moist,			
	CL	FILL, SILTY CLAY, strong chemical smell, whitish gray brown, very moist, rather soft,	4		
	PT	PEAT-MUCK, slight chemical smell, dark brown, wet, (Swamp Deposit)	5		
	ML	CLAYEY SILT, slight chemical smell, rather moist. medium. (Alluvium)	7		
25.5	SP	SAND, with some gravel, slight chemical smell, gray, waterbearing, loose to medium dense, (Glacial Outwash)	4		
		Water level down 11' immediately after withdrawal of auger. *(possibly industrial waste)	9		

Standard Plc for actual and descr

LOG OF BORING



PROJECT: 71-53 SOIL BORINGS
Louisiana Avenue Extension
St. Louis Park, Minnesota

BORING: ST-53

LOCATION: 30' South of South-east bridge corner stake.

DATE: 3/5/75

SCALE: 1"=5'

Elev.	Depth 0	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
		PT	PEAT and MUCK, dark brown to olive, moist to wet, (Swamp Deposit)			
	30					
			(continued on following page.)			

(See Report and Standard Plates for evaluation and descriptive terminology.)

50010803

LOG OF BORING



PROJECT: 71-53 SOIL BORINGS Louisiana Avenue Extension St. Louis Park, Minnesota	BORING: ST-53 continued LOCATION: 30' South of South-east bridge corner stake.
DATE: 3/5/75	
SCALE: 1"=5'	

iv.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
	34	PT	MUCK, olive, wet, (Swamp Deposit)			Page 2 of 3
	39	SP	SAND, medium to coarse grained, with some gravel, slight chemical smell, gray, waterbearing, loose, (Glacial Outwash)	8		
	49	SM	SAND mixed with PEAT, with slight chemical smell, dark brown to black, wet, loose	9		
				7		
	52.5	SC	CLAYEY SAND, slight chemical smell, gray, wet, very stiff, (Alluvium)	25		
	60	SP	SAND, slight chemical smell, gray, waterbearing, loose, (Glacial Outwash)	8		
			(continued on following page)	11		
			Jetting water used to clear the auger below the 35-foot depth.			

50010804

LOG OF BORING



PROJECT: 71-53 SOIL BORINGS
Louisiana Avenue Extension
St. Louis Park, Minnesota

BORING: ST-53 continued

LOCATION:

DATE: 3/5/75

SCALE: 1"=5'

Elev.	Depth 60	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
	68	SP	SAND, medium to coarse grained, with some gravel, slightly chemical smell, gray, waterbearing, dense, (Glacial Outwash)	30		Page 3 of 3
	71	SP	SAND, fine to medium grained, with a little gravel, slight chemical smell, gray, waterbearing, loose, (Glacial Outwash)	5		
	79	ML	CLAYEY SANDY SILT, with a trace of gravel, reddish brown, wet, very stiff, (Glacial Till)	29		
	84	SM	SILTY SAND, with limestone chunks; (Possibly weathered Plattville Formation) gray, waterbearing, very dense	60		
	90		SANDSTONE, light greenish, waterbearing, very dense, (Possibly Glenwood Formation) immediately above St. Peter Sandstone Formation)	100		
			Water level down 6' 15minutes after completion of boring. Jetting water used to clear the auger below the 35-foot depth.	200		

(See Report and Standard Plates for evaluation and descriptive terminology.)

50-1-8-5

GCA REPORT
Project No. 1-519-073
December, 1983

[illegible]

7

Sample No.	Sample Location	Sample Depth (ft)	Sample Weight (lb)	Sample Volume (cc)	Sample Density (g/cc)	Sample Color	Sample Description	Sample Classification	Notes on Sample Location, Sample Return, Character of Drilling, etc.
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SECRET

East of Louisiana Ave.. South of Gordon Millwork

100-152

Office: 1330

BRAUN REPORT

Project No. 79-687

For USGS

January, 1980

LOG OF BORING



PROJECT: 79-687 SOIL BORINGS AND PIEZOMETER .
INVESTIGATION
Various Locations
St. Louis Park, MN
U.S. Geological Survey

BORING: B-108

LOCATION: North Side of Oxford
and West of Edgewood

DATE: 1/21 - 1/22/89 SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
	0					
	1	SM	(Fill) SILTY SAND, fine to medium-grained, dark brown, frozen.			Sheet 1 of 3 Boring advanced by roller-bit below the 16' depth. Location of boring determined by U.S.G.S. Surface elevation of boring to be determined by U.S.G.S. Soil Classifications based on drillers log and visual examination of random frozen samples returned to Braun Engineering Testing Laboratory. BPF does not indicate standard penetration test results since special sampling procedures were used.
	4.5	SP-SM	(Fill) SAND TO SILTY SAND, fine to medium-grained, with a trace of fine Gravel, brown to dark brown, moist.			
	7	SP-SM	SAND, SLIGHTLY SILTY, fine to medium-grained, brown, moist to wet, medium dense to dense. (Outwash)	14 9 10 9		
		SP	SAND, fine to medium-grained, with a trace of fine Gravel, brown, wet, medium dense to dense. (Outwash)	3 10 10 10 15 7 7 7		
	19.5			18 17 17 21		
		SP	SAND, fine to medium-grained, gray to brown with depth, wet, medium dense to dense. (Outwash)	17 18 19 23		
	30			8 11		

9636529

LOG OF BORING



PROJECT: 79-687 SOIL BORINGS AND PIEZOMETER
INVESTIGATION
Various Locations
St. Louis Park, MN
U.S. Geological Survey

BORING: B-108 Cont'd

LOCATION:

DATE: 1/21 - 1/22/80 **SCALE:** 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth 30	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
		SP	SAND, fine to medium-grained, gray to brown with depth, wet, medium dense to dense. (Outwash)	11 11 29 18 17 11 8 8 13 13 18 10 11 11		Sheet 2 of 3
	47	SP-SM	SAND, SLIGHTLY SILTY, fine to medium-grained, with a trace of fine Gravel, reddish brown, wet, dense to very dense. (Outwash)	51 46 36 25		
	51	SP	SAND, fine to medium-grained, with a trace of Gravel, gray to brown, wet, dense to very dense. (Outwash)	32 32 34 26 92 85 58 56		
	60					

9636530

BRA I I
ENGINEERING TESTING

BORING-B-108 Contr'd

DATE: 1/21 - 1/22/85 SCALE: 1" = 4'

[illegible]

(See Report and Standard Plates for evaluation and descriptive terminology.)

9636531

BARR REPORT

Project No. 71-53

February, 1975

LOG OF BORING elev 885±5

ENGINEERING TESTING

89

PROJECT: 71-53 SOIL BORINGS
Louisiana Avenue Extension
St. Louis Park, MN

UNIQUE NUMBER 7863

BORING: ST-1

LOCATION:

63' North of Northwest Corner
of proposed bridge abutment.

DATE: 2/4/75

SCALE: 1"=5'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	SPF	WL	Tests or Notes
	0					Page 1 of 3
	6	SC	FILL, SILTY CLAYEY SAND, with some concrete chunks, dark brown, frozen to moist, hard to soft	57		Penetration resistance at the 3' depth is not representative due to the frozen soil conditi.
				2		
		PT	PEAT, organic, fibrous, black to dark brown, moist to wet, (Swamp Deposit)	2		
				2		
	13			2		
		PT	MUCK, organic, with a trace of shells, dark olive brown, moist to wet, (Swamp Deposit)	2		
				2		
				3		
				2		
	34					
		SP	SAND, with a trace of gravel, gray, waterbearing, loose, (Glacial Outwash)	5		

Sample depth-29'-30'
OC = 33.42
MC = 205.52

(Continued on following page)

9601593

(See Report and Standard Plates for evaluation and descriptive terminology.)

LOG OF BORING



90

PROJECT: 71-53 SOIL BORINGS
Louisiana Avenue Extension
St. Louis Park, MN

BORING: ST-1 (continued)

LOCATION:

7863

DATE: 2/5/75

SCALE: 1"=5'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	SPF	WL	Tests or Notes
	35	SP	SAND, with a trace of gravel, gray, waterbearing, loose, (Glacial Outwash)	9		Page 2 of 3
	49	CL	SILTY SANDY CLAY, with some gravel, gray, wet, stiff to very stiff, (Glacial Till)	15		
	58	SP	SAND, with some gravel, : : gray, waterbearing, medium dense, (Glacial Outwash)	22		
				14		
				16		
	72			17		

(See Report and Standard Plates for evaluation and descriptive terminology.)

(continued on following page)

9601594

LOG OF BORING



91

PROJECT: 71-53 SOIL BORINGS
Louisiana Avenue Extension
St. Louis Park, MN

BORING: ST-1 (continued)

LOCATION:

7863

DATE: 2/5/75

SCALE: 1"=5'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
	70					Page 3 of 3
		SP	SAND, with some gravel, gray, waterbearing, medium dense, (Glacial Outwash)	9		
	77					
		SP- SI	SAND, slightly SILTY, fine to medium grained, reddish brown, waterbearing, (Alluvium)	14		
704.3	84					
			SHALY SANDSTONE, greenish, (Glenwood Formation).	42		
	87					
			SANDSTONE, light brown, (St. Peter Formation)	150		Blows in 5"
83.0 710.3 793.3	95		Boring terminated due to refusal in the St. Peter Sandstone Formation. Water level down 13' 15 minutes after completion of boring.	100		Blows in 2"

605
/

79
/

(See Report and Standard Plates for evaluation and descriptive terminology.)

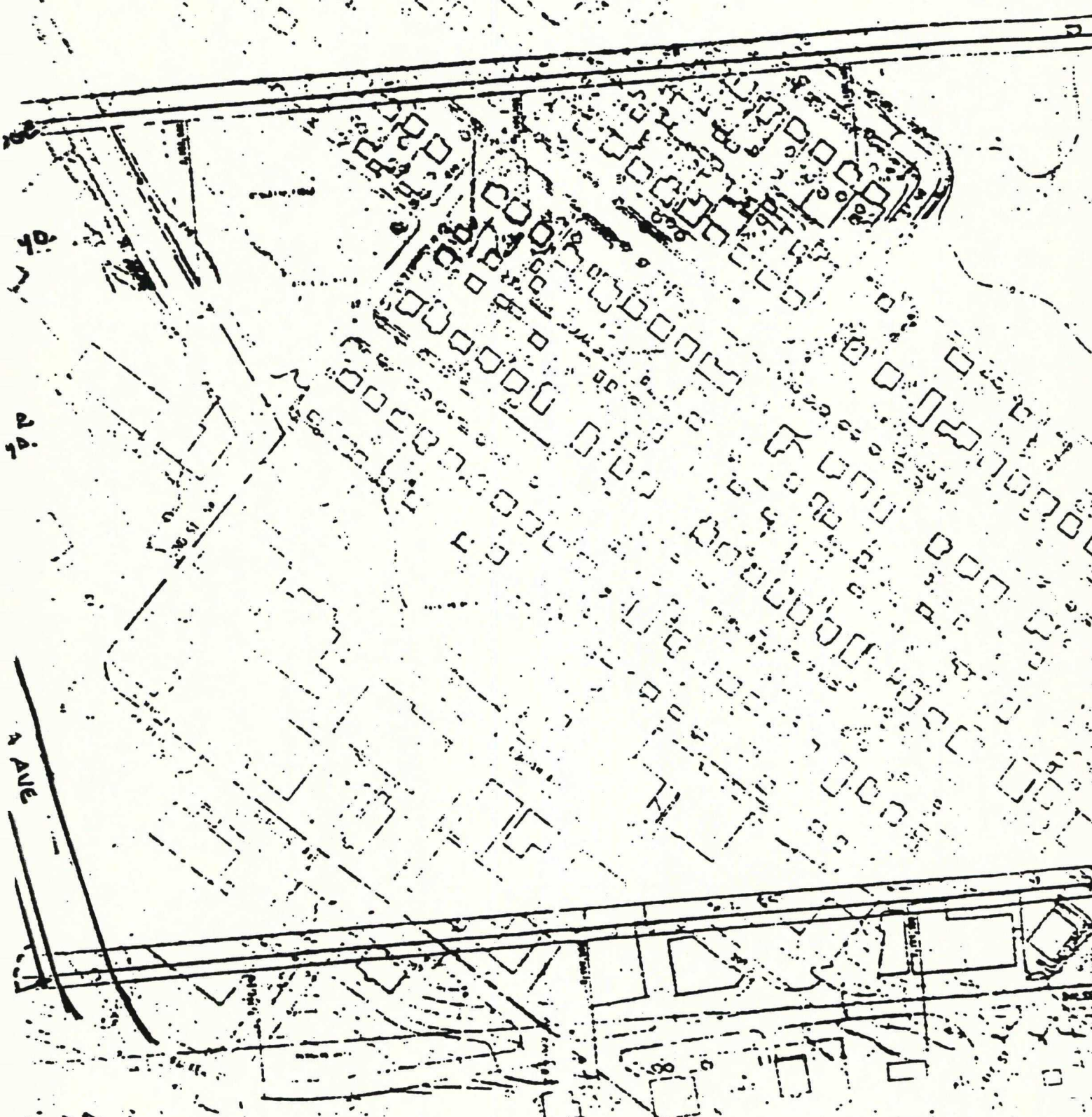
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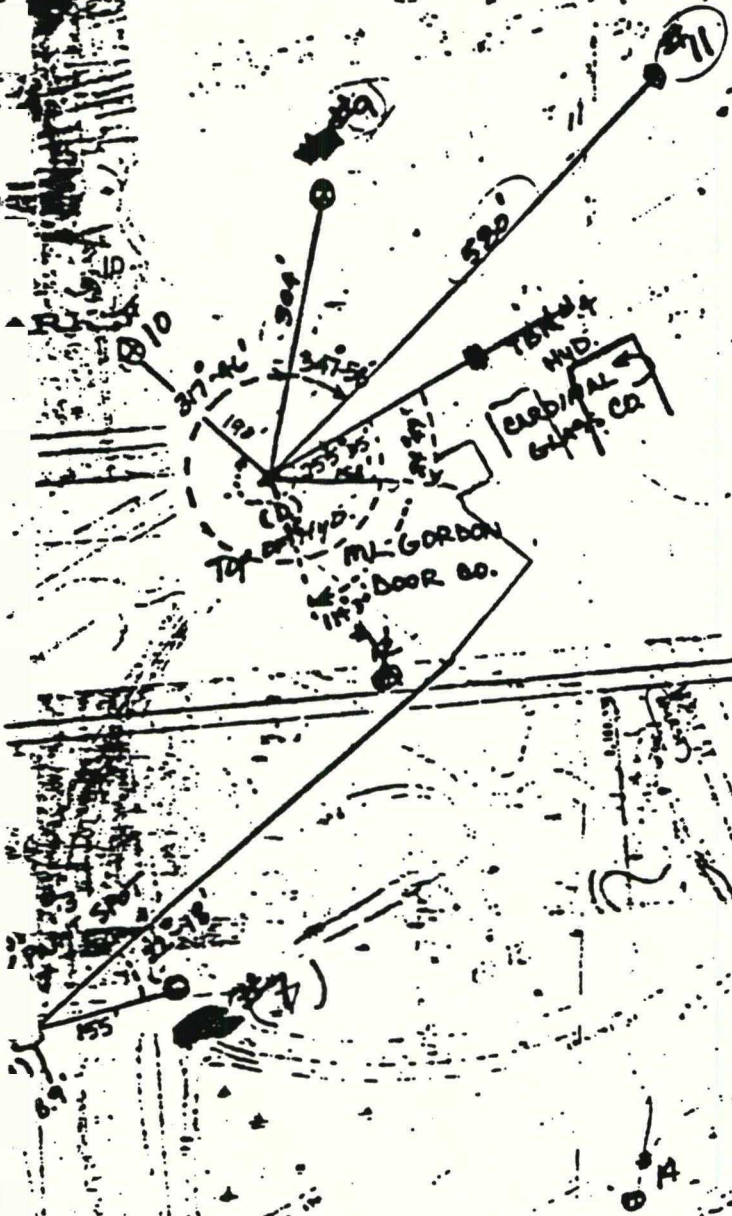
9601598



CS.2706 ELEV. 913.30

9601599

Stn. CS.2706 ELEV. 913.30



LOG OF BORING



86

PROJECT: 71-53 SOIL BORINGS
Louisiana Avenue Extension
St. Louis Park, Minnesota

BORING: ST-53

LOCATION: 30' South of South-east bridge corner stake.

UNIQUE NUMBER 7864

DATE: 3/5/75

SCALE: 1"=5'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2487)	BPF	WL	Tests or Notes
	0	PT	PEAT and MUCK, dark brown to olive, moist to wet, (Swamp Deposit)			
	30					

(continued on following page.)

(See Report and Standard Plates for evaluation and descriptive terminology.)

9601590

LOG OF BORING



87

PROJECT: 71-53 SOIL BORINGS
Louisiana Avenue Extension
St. Louis Park, Minnesota

BORING: ST-53 continued
LOCATION: 30' South of South-
east bridge corner stake.

7864

DATE: 3/5/75

SCALE: 1"=5'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth 30	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
	34	PT	MUCK, olive, wet, (Swamp Deposit)			
	39	SP	SAND, medium to coarse grained, with some gravel, slight chemical smell, gray, waterbearing, loose, (Glacial Outwash)	8		
	49	SM	SAND mixed with PEAT, with slight chemical smell, dark brown to black, wet, loose	9		
				7		
	52.5	SC	CLAYEY SAND, slight chemical smell, gray, wet, Very stiff, (Alluvium)	25		
	60	SP	SAND, slight chemical smell, gray, waterbearing, loose, (Glacial Outwash)	8		
			(continued on following page) Jetting water used to clear the auger below the 35-foot depth.	11		

9601591

LOG OF BORING

ENGINEERING TESTING

88

PROJECT: 71-53 SOIL BORINGS
Louisiana Avenue Extension
St. Louis Park, Minnesota

BORING: ST-53 continued

LOCATION:

7864

DATE: 3/5/75

SCALE: 1"=5'

Elev.	Depth 60	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
	68	SP	SAND, medium to coarse grained, with some gravel, slightly chemical smell, gray, waterbearing, dense, (Glacial Outwash)	30		
	71	SP	SAND, fine to medium grained, with a little gravel, slight chemical smell, gray, waterbearing, loose, (Glacial Outwash)	5		
	79	ML	CLAYEY SANDY SILT, with a trace of gravel, reddish brown, wet, very stiff, (Glacial Till)	29		
	84	SM	SILTY SAND, with limestone chunks; (Possibly weathered Plattville Formation) gray; waterbearing, very dense	60		
	90		SANDSTONE, light greenish, waterbearing, very dense, (Possibly Glenwood Formation). Immediately above St. Peter Sandstone Formation)	100		
			Water level down 6' 15 minutes after 200 blows in 6" completion of boring. Jetting water used to clear the auger below the 35-foot depth.			

(See Report and Standard Plates for evaluation and descriptive terminology.)

9601592

PROJECT: 71-53 Soil Investigation
 Louisiana Avenue Extension
 Oxford Road to Walker Street
 St. Louis Park, Minnesota

UNIQUE NUMBER: 7962

BORING: ST-64 83
 LOCATION: Railroad Extension
 Approximate Station 2+95904
 ele. 515.5
 DATE: 5/15/75 SCALE: 1"=5'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2487)	BPF	WL	Tests or Notes
194.5	0					
		SP	FILL, SAND, slightly SILTY, fine to medium grained, with a little fine to medium gravel, brown, a trace of cinders at 10', moist to wet at 15', very loose	5		
				4		
						Gravel 10%
						Coarse Sand 10%
						Medium Sand 10%
				4		Fine Sand 39%
						Silt and Clay 5%
175.5	19					
		CL	FILL, SANDY CLAY, with a little gravel, brown and gray, very wet, soft	3		MC = 17.0%
172.5	22					
		SP	SAND, slightly SILTY, medium grained, a little gravel, gray and dark gray, a few lenses of brown clay and black silty clay, waterbearing, loose to medium dense (possibly fill)	9		
				11		
						Gravel 7%
						Coarse Sand 11%
				8		Medium Sand 33%
						Fine Sand 37%
						Silt and Clay 12%
155.5	39					

continued on next page

9601587

(See Report and Standard Plates for evaluation and descriptive terminology.)

LOG OF BORING



84

PROJECT: 71-53 Soil Investigation
Louisiana Avenue Extension
Oxford Road to Walker Street
St. Louis Park, Minnesota

BORING: ST-64 (continued)

LOCATION:

7862

DATE: 5/15/75

SCALE: 1"=5'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	SPF	WL	Tests or Notes
155.5	39					
150.0	44.5	SP	SAND, coarse grained, with gravel, gray, waterbearing, medium dense (Coarse Alluvium)	15		Gravel 44% Coarse Sand 27% Medium Sand 22% Fine Sand 6% Silt and Clay 1%
		PT	MUCK, olive, a layer of moist gray sand at 60', moist (Swamp Deposit)	16		MC = 142.2% OC = 48.1% DD = 29.8 pcf MC = 154.1%
				17		MC = 138.5% OC = 33.1% DD = 28.1 pcf MC = 169.4%
				19		MC = 141.8% OC = 65.4% DD = 32.4 pcf MC = 144.8%
132.5	62			32		MC = 126.8% OC = 38.7% DD = 28.5 pcf MC = 161.9%
125.5	69	SP-SM	SAND, slightly silty, fine to coarse grained, some gravel, gray, waterbearing, medium dense	19		Gravel 36% Coarse Sand 17% Medium Sand 30% Fine Sand 12% Silt and Clay 5%
		SP-SM	SAND, slightly silty, fine grained, dark gray, waterbearing, medium dense	12		
115.5	79			16		Gravel 0% Coarse Sand 4% Medium Sand 35% Fine Sand 46% Silt and Clay 12%

continued on next page

9601588

LOG OF BORING

WILSON
ENGINEERING TESTING

85

PROJECT: 71-53 Soil Investigation
Louisiana Avenue Extension
Oxford Road to Walker Street
St. Louis Park, Minnesota

7862

BORING: ST-64 (continued)

LOCATION:

elev. 895.15

DATE: 5/15/75

SCALE: 1"=5'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2487)	BPF	WL	Tests or Notes
115.5	79					
		SP-SM	SAND, slightly silty, fine grained, gray, waterbearing, medium dense	15		
111.5	83					
		SC	CLAYEY SAND, a little gravel, gray to reddish brown, moist to wet, very stiff (Glacial Till)	34		
				42		Ru = 2390 psf MC = 11.6%
				81		
96.5	98					
710.3 ~90			SANDSTONE, greenish white, wet, very dense (St. Peter Formation)			--100 blows to penetrate 3"
89.7 (90.1)	104.8					--200 blows to penetrate 2"
			Water level at 12' when measured immediately after completion with hollow-stem auger removed.			

795
02
77

9601589

SEC REPORT

Project No. 20070

February, 1974

SOIL EXPLORATION

92

JOB NO. **20070** VERTICAL SCALE **1" = 4'** LOG OF TEST BORING NO. **15**
 PROJECT **PROPOSED STORM SEWER AND HOLDING POND - ST LOUIS PARK, MINNESOTA**

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	L.L. P.L.	Qu
	SURFACE ELEVATION 178.5'									
4	FILL, a mixture of SAND, SILTY SAND and CLAYEY SAND, a little gravel, dark brown and brown, frozen to 1'	FILL			1	SS				
			4		2	SS				
	PEAT, fine fibrous, black, wet (Pt)	SWAMP DEPOSIT	2		3	SS				
	MUCK, black, soft (Pt)		2		4	SS				
9	SAND, medium to coarse grained, some gravel, grayish brown to brown, water-bearing, medium dense to loose to medium dense, a few lenses of silty sand (SP)	COARSE ALLUVIUM	10		5	SS				
			9		6	SS				
			6		7	SS				
			10		8	SS				
22	End of Boring									

WATER LEVEL MEASUREMENTS							START	COMPLETE
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BALED DEPTHS	WATER LEVEL	2-18-74	2-18-74
2-18	3:40	22'	19½'		so	8'	METHOD 3½ HSA 0' - 19½'	e 3:40
2-18	3:55	22'	None		so	7'		
					so		9501737	

SOIL EXPLORATION

93

JOB NO. 20070 VERTICAL SCALE 1" = 4' LOG OF TEST BORING NO. 16
 PROJECT PROPOSED STORM SEWER AND HOLDING POND - ST LOUIS PARK, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	$\frac{L.L.}{P.L.}$	Qu
	<u>SURFACE ELEVATION 175.8'</u>									
4 1/2	PEAT, fine fibrous, black, frozen to 1/2' then wet (Pt)	SWAMP DEPOSIT	1 1/2		1	SS				
			2		2	SS				
	MUCK, gray, soft (Pt)		1/1 1/2'		3	SS				
			2		4	SS				
14			1		5	SS				
			2		6	SS				
	ORGANIC SILTY CLAY, gray, medium (OL)		5		7	SS				
18	SAND, medium grained, some gravel, gray, waterbearing, very loose to loose (SP)	COARSE ALLUVIUM	4		8	SS				
			8		9	SS				
27	End of Boring									

WATER LEVEL MEASUREMENTS							START <u>2-18-74</u>	COMPLETE <u>2-18-74</u>
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD <u>3 1/2 HSA 0' - 24 1/2'</u> @ <u>2:20</u>	
2-18	2:20	27'	24 1/2'		no	4'	9601738	
2-18	2:35	27'	None		no	2'		
					no			

— **11** —

JOB NO. 20070 VERTICAL SCALE 1" = 4' LOG OF TEST BORING NO. 17
PROJECT PROPOSED STORM SEWER AND HOLDING POND - ST LOUIS PARK, MINNESOTA

9601739

CHEMICAL TEST RESULTS

Job No 20070

<u>BORING NUMBER</u>	<u>SAMPLE DESCRIPTION</u>	<u>SAMPLE DEPTH</u>	<u>SAMPLE ELEVATION</u>	<u>CHEMICAL CONCENTRATIONS (mg/l)</u>	
				<u>PHENOLS</u>	<u>OIL, GREASE, & PARAFFIN</u>
5	Water	25'	152.3	7.3	4685 #10
5	Soil	20'-21'	156.3-157.3	N.D.*	150' mg/Kg 3230
5	Soil	40'-41'	136.3-137.3	N.D.*	160 180
5	Soil	60'-61'	116.3-117.3	N.D.*	160 135
13	Water	35'	142.8	25.5	3138 #11
13	Soil	20'-21'	156.8-157.8	6.3	272 140
13	Soil	45'-46'	131.8-132.8	15.5	27,000 90
13	Soil	50'-51'	126.8-127.8	5.8	2216 115
5, 7, 9, 13 & 14	Soil	0'-9'	Above 168	91.4	115,000
16 & 17	Soil	0'-8'	Above 168	1.3	1265 #7
16	Soil	20'-21'	154.8-155.8	N.D.*	372 < 50
(Bag)	100% Soil			N.D.*	21,795
(Bag)	50% Soil-50% Creosote			1.9	39,614
(Bag)	100% Creosote			16.3	119,034

*None detected. Test sensitive to concentration of more
than 0.01 mg/l

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS

SYMBOL	DEFINITION
C.S.	Continuous Sampling
P.D.	2-3/8" Pipe Drill
C.O.	Cleanout Tube
3 1/4" HSA	3 1/4" I.D. Hollow Stem Auger
4 FA	4" Diameter Flight Auger
6 FA	6" Diameter Flight Auger
2 1/2" C	2 1/2" Casing
4C	4" Casing
D.M.	Drilling Mud
J.W.	Jet Water
H.A.	Hand Auger
NXC	Size NX Casing
BXC	Size BX Casing
AXC	Size AX Casing
SS	2" O.D. Split Spoon Sample
2T	2" Thin Wall Tube Sample
3T	3" Thin Wall Tube Sample

LABORATORY TEST SYMBOLS

SYMBOL	DEFINITION
W	Moisture content - percent of dry weight
D	Dry density-pounds per cubic foot
LL PL	Liquid and plastic limits determined in accordance with ASTM D 423 and D 424
Qu	Unconfined compressive strength-pounds per square foot in accordance with ASTM D 2186-66
Additional insertions in Qu column	
Pq	Penetrometer reading-tons/square foot
Ts	Torvane reading-tons/square foot
G	Specific gravity - ASTM D 854-58
SL	Shrinkage limit - ASTM D 427-61
pH	Hydrogen ion content-meter method
O	Organic content-combustion method
M.A.*	Grain size analysis
C*	One dimensional consolidation
Qc*	Triaxial compression

*See attached data sheet end/or graph

WATER LEVEL

SYMBOL - 

Water levels shown on the boring logs are the levels measured in the borings at the time and under the conditions indicated. In sand, the indicated levels can be considered reliable ground water levels. In clay soil, it is not possible to determine the ground water level within the normal scope of a test boring investigation, except where lenses or layers of more pervious waterbearing soil are present and then a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level symbol for cohesive or mixed texture soils may not indicate the true level of the ground water table. The available water level information is given at the bottom of the log sheet.

DESCRIPTIVE TERMINOLOGY

DENSITY		CONSISTENCY	
TERM	"N" VALUE	TERM	"N" VALUE
Very loose	0-4	Soft	0-4
Loose	5-8	Medium	5-8
Medium Dense	9-15	Rather Stiff	9-15
Dense	16-30	Stiff	16-30
Very Dense	Over 30	Very Stiff	Over 30

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch OD split spoon.

RELATIVE PROPORTIONS

TERM	RANGE
Trace	0-5%
A Little	5-15%
Some	15-30%
With	30-50%

PARTICLE SIZES

Boulders	Over 3"
Gravel	
Coarse	3/4"-3"
Fine	3/4"-1/4"
Sand	
Coarse	#4-#10
Medium	#10-#40
Fine	#40-#200
Silt and Clay	Determined by plasticity Characteristics

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487 - 69 AND D 2488 - 69

(Unified Soil Classification System)

Major divisions		Group symbols	Typical names	Classification criteria	
Coarse-grained soils More than 50% retained on No. 200 sieve*	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 Not meeting both criteria for GW
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 Atterberg limits above "A" line with P.I. greater than 7 Atterberg limits plotting in hatched area are <i>borderline</i> classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 Not meeting both criteria for SW
			SP	Poorly graded sands and gravelly sands, little or no fines	
		Sands with fines	SP _s	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 Atterberg limits above "A" line with P.I. greater than 7 Atterberg limits plotting in hatched area are <i>borderline</i> classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	
	Fine-grained soils 77.4% or more passes No. 200 sieve*	Silt and clays Liquid limit 50% or less	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	Plasticity Chart For classification of fine-grained soils and fine fraction of coarse-grained soils. Atterberg Limits plotting in hatched area are <i>borderline</i> classifications requiring use of dual symbols. Equation of A-line: $P_i = 0.73 (LL - 20)$ Plasticity Index
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
		Silt and clays Liquid limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	
			CH	Inorganic clays of high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity	
	Highly organic soils	Pe	Peat, muck and other highly organic soils		

*Based on the material passing the 3 in. (76 mm) sieve.

9601742

SEC REPORT

Project No. 21160

December, 1974

SOIL EXPLORATION

CONTINUED

113

JOB NO. 21160 VERTICAL SCALE 1" = 4' LOG OF TEST BORING NO. 21
PROJECT PROPOSED STORM WATER PONDS - ST. LOUIS PARK, MN

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION 178.72'	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	QU
2 1/2	FILL, mostly CONCRETE, grayish brown	FILL			1	HSA				
	PEAT, fine fibrous, black and dark brown, wet	SWAMP DEPOSIT	3		2	SS				
	(Pt)		1 1/2		3	SS				
			1 1/2		4	SS				
8	CLAYEY SILT, gray, soft	FINE ALLUVIUM			5	SS				
9	(CL-ML)									
14	SAND, mostly medium grained, a little gravel, brown, waterbearing, loose to medium dense	COARSE ALLUVIUM	8		6	SS				M.A.
	(SP-SM)		14		7	SS				
	SAND, medium to coarse grained, with gravel, brown, waterbearing, medium dense to very dense to dense		14		8	SS				M.A.
	(SP)		16		--	--				
26			33		--	--				
	Continued on next page									

9601758

SOIL EXPLORATION

COMPANY

114

JOB NO. 21160 VERTICAL SCALE 1" = 4' LOG OF TEST BORING NO. 21 Cont

PROJECT PROPOSED STORM WATER PONDS - ST LOUIS PARK, MN

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	L.L. P.L.	Qu
26			23		9	SS				
32	End of Boring									
	* No measurement recorded due to presence of drilling fluid.									

WATER LEVEL MEASUREMENTS							START	12-12-74	COMPLETE	12-13-74
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD			
12-13	9:10	11½'	9½'	10'	to	7'	3½ HSA 0' - 29½'			
12-13	10:45	32'	29½'		to	*	D.M. 9½' - 29½'			
12-13	11:05	32'	None		to	*				
					to		CREW CHIEF White 9601759			

SOIL EXPLORATION

115

JOB NO. 21160 VERTICAL SCALE 1" = 4' LOG OF TEST BORING NO. 22
 PROJECT PROPOSED STORM WATER PONDS - ST. LOUIS PARK, MN

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>179.44'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
2 1/2	FILL, mixture of SILTY SAND and SAND, a little gravel, black and brown, frozen to 0.2'	FILL	5		1	SS				
	PEAT, fine fibrous, black and dark brown, moist, a few lenses of sand (Pt)	SWAMP DEPOSIT	3		2 3	SS SS				
4	SAND, medium grained, a little gravel, brown and gray, moist to 7' then waterbearing, loose to medium dense, a few lenses of black silty sand	COARSE ALLUVIUM	6		4	SS				
					5	SS				
			9		6	SS				
			9		--	--				
			8		7	SS				
9	(SP-SM)		7		8	SS				
	SAND, medium grained, a little gravel, brown, waterbearing, loose to medium dense, a few lenses of silty sand		9		9	SS				
	(SP)									
23	SANDY CLAY, gray, soft (CL)	MIXED ALLUVIUM			10	SS				
25			8		11	SS				
	SAND, medium to coarse grained, a little gravel, brown, waterbearing, loose to dense (SP)		8		--	--				
36	Continued on next page		12		12	SS				

M.A.

9601760

SOIL EXPLORATION

COMPANY

21160

VERTICAL SCALE

1" = 4'

LOG OF TEST BORING NO.

22 Cont.

116

19

10

2M V 2

DESCRIPTION OF MATERIAL

GEOLOGIC
ORIGIN

SAMPLE
N WL NO TYPE

LABORATORY TESTS

W D $\frac{LL}{PI}$ Qu

STS

Qu

14 1 SS

17 1 SS

15 1 SS

15 1 SS

18 1 SS

36 1 SS

TILL

LIMESTONE

1 *

WATER LEVEL MEASUREMENTS

TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BALED DEPTHS	WATER LEVEL
1:15					

START 12-13-74 COMPLETE 12-16-74

METHOD 3 1/2 HSA 0' - 44 1/2' @ 10:35

D.M. 9 1/2' - 68.1'

9601761

CREW CHIEF

White

12-12-74

@ 2:40

1764

), medium grained, a little
red, brown, waterbearing,
medium dense to dense

(SP)

drilling fluid wash sample

No measurement recorded due to
absence of drilling fluid

CLAYEY SAND, a little gravel,
reddish brown, very stiff

(SC)

gray

SOIL EXPLORATION

121

JOB NO. 21160 VERTICAL SCALE 1" = 4' LOG OF TEST BORING NO. 27
 PROJECT PROPOSED STORM WATER PONDS - ST LOUIS PARK, MN

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>180.84'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
	FILL, mostly GRAVEL, brown	FILL	2		1	SS				
1 1/2	FILL, mostly CLAYEY SAND, a little				2	SS				
2 1/2	gravel, black		8		3	SS				
	FILL, mixture of SAND and SILTY SAND, a trace of gravel, brown, water in fill below 12'		9		4	SS				
			9		5	SS				
			5		6	SS				
			4		7	SS				
15 1/2	MUCK, black, soft (Pt)	SWAMP DEPOSIT	1 1/2		8	SS				
18			7		9	SS				
	SAND, medium grained, a little gravel, gray, waterbearing, loose (SP)	COARSE ALLUVIUM	7		10	SS				
			7		11	SS				
24	SAND, coarse grained, with gravel, brown, waterbearing, dense to medium dense (SP)		16		12	SS				
	* No measurement recorded due to presence of drilling fluid.		13		--	--				
32	End of Boring									

WATER LEVEL MEASUREMENTS							START	12-13-74	COMPLETE	12-13-
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BALED DEPTHS	WATER LEVEL	METHOD	3 1/2 HSA 0' - 19 1/2'	@	3:0
12-13	1:50	13 1/2'	12'	13'	"	12'		D.M., 19 1/2' - 29 1/2'		
12-13	2:10	19 1/2'	17'	18 1/2'	"	18'				
12-13	3:00	32'	19 1/2'		"	*				
12-13	3:20	32'	None		"	*				
							CREW CHIEF	Chermak		

9601766

SOIL EXPLORATION

CONTINUED

122

JOB NO. 21160 VERTICAL SCALE 1" = 4' LOG OF TEST BORING NO. 28
 PROJECT PROPOSED STORM WATER PONDS - ST. LOUIS PARK, MN

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
	SURFACE ELEVATION 182.79'				NO	TYPE	W	D	LL PL	Qu
4 1/2	FILL, mostly SILTY SAND, a little gravel, dark grayish brown, frozen to 0.2' .	FILL	6		1	SS				
			6		2	SS				
			7		3	SS				
			6		4	SS				
			3		5	SS				
			7		6	SS				
14	PEAT, black, wet (Pt)	SWAMP DEPOSIT			7	SS				
15	SAND, medium to coarse grained, a little gravel, gray, waterbearing, loose to medium dense (SP)	COARSE ALLUVIUM	8		8	SS				
	8			9	SS					
	15			10	SS					
	9			11	SS					
32	* No measurement recorded due to presence of drilling fluid.									
	End of Boring									

WATER LEVEL MEASUREMENTS							START	COMPLETE
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BALED DEPTHS	WATER LEVEL	12-16-74	12-16-
12-16	1:05	11 1/2'	9 1/2'	9 1/2' +	10	9 1/2'	METHOD 3 1/2 HSA 0' - 9 1/2'	@ 2:5
12-16	2:50	32'	9 1/2'		10	*	D.M. 9 1/2' - 29 1/2'	
12-16	3:00	32'	None		10	*		
					10			
							9601767	
							CREW CHIEF White	

REPORT OF TESTS OF SOIL

PROJECT: PROPOSED STORM WATER PONDS
ST. LOUIS PARK, MINNESOTA

REPORTED TO: City of St. Louis Park

LABORATORY NUMBER: 21160

BORING NUMBER:	19	20	21
SAMPLE NUMBER:	6	8	6
Depth Sample Taken (Ft.)	12½-13½	20-21	10-11
Classification (ASTM: D 2487-69)	SP	SP	SP-SM
Description (ASTM: D 2488-69)	Sand, mostly medium grained	Sand, mostly medium grained	Sand, mostly medium grained

MECHANICAL ANALYSIS:

Dry Weight of Total Sample (grams)	180	180	180
Based on Total Sample:			
Gravel - % (On #4)	24	7	26
Based on #4 Material			
Sand - % (#4 - #10)	22	10	19
(#10 - #40)	55	62	43
(#40 - #100)	16	25	27
(#100 - #200)	2	1	3
Fines - % (#200 Down)	5	2	8

9601768

REPORT OF TESTS OF SOILS

PROJECT: PROPOSED STORM WATER PONDS
ST. LOUIS PARK, MINNESOTA

REPORTED TO: City of St. Louis Park

LABORATORY NUMBER: 21160

BORING NUMBER:	21	22	23
SAMPLE NUMBER:	8	7	6
Depth Sample Taken (Ft.)	15-16	12½-13½	9-10
Classification (ASTM: D 2487-69)	SP	SP-SM	SM
Description (ASTM: D 2488-69)	Sand, medium to coarse grained	Sand, medium to fine grained	Silty Sand, fine to medium grained

MECHANICAL ANALYSIS:

Dry Weight of Total Sample (grams)	270	290	140
Based on Total Sample:			
Gravel - % (On #4)	37	19	11
Based on -#4 Material			
Sand - % (#4 - #10)	30	16	7
(#10 - #40)	50	43	30
(#40 - #100)	13	21	34
(#100 - #200)	2	5	9
Fines - % (#200 Down)	5	15	20

REPORT OF TESTS OF SOIL

PROJECT: PROPOSED STORM WATER PONDS
ST. LOUIS PARK, MINNESOTA

REPORTED TO: City of St. Louis Park

LABORATORY NUMBER: 21160

BORING NUMBER:	24	24
SAMPLE NUMBER:	5	9
Depth Sample Taken (Ft.)	7½-8½	12½-13½
Classification (ASTM: D 2487-69)	SM	SP
Description (ASTM: D 2488-69)	Silty Sand, fine to medium grained	Sand, mostly medium grained

MECHANICAL ANALYSIS:

Dry Weight of Total Sample (grams)	190	190
Based on Total Sample: ..		
Gravel - % (On #4)	14	0
Based on -#4 Material		
Sand - % (#4 - #10)	9	2
.. (#10 - #40)	49	84
(#40 - #100)	24	11
(#100 - #200)	3	1
Fines - % (#200 Down)	15	2

9601770

CHEMICAL TEST RESULTS

PROJECT: Proposed Storm Water Ponds
St Louis Park, Minnesota

REPORTED TO: City of St Louis Park

LABORATORY NUMBER: 21160

BORING NUMBER	SAMPLE DESCRIPTION	SAMPLE DEPTH	SAMPLE ELEVATION	CHEMICAL CONCENTRATIONS (mg/l)	
				PHENOLS	OIL, GREASE & PARAFFIN
19	Soil	1-1½'	181.0'	0.1*	1280
19	Soil	2½-3½'	179.0'	0.4	390
19	Soil	10-11'	171.5'	0.1*	310
20	Soil	2½-3½'	178.3'	0.1	742
20	Soil	7½-8½'	173.3'	0.2	2170
20	Soil	12½-13½'	168.3'	29	4190
21	Soil	5-6'	173.2'	0.3	5630
22	Soil	7½-8½'	171.4'	0.2	346
23	Soil	1-1½'	173.8'	1.4	28000
24	Soil	5-6'	170.6'	0.3	3420

#5
9300 6.6
4830 2.2
1100 1.2

*Less than

9601771

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS

SYMBOL	DEFINITION
C.S.	Continuous Sampling
P.D.	2-3/8" Pipe Drill
C.O.	Cleanout Tube
3K HSA	3K" I.D. Hollow Stem Auger
4 FA	4" Diameter Flight Auger
6 FA	6" Diameter Flight Auger
2N C	2 3/4" Casing
4C	4" Casing
D.M.	Drilling Mud
J. W.	Jet Water
M. A.	Hand Auger
NXC	Size NX Casing
BXC	Size BX Casing
AXC	Size AX Casing
SS	2" O.D. Split Spoon Sample
2T	2" Thin Wall Tube Sample
3T	3" Thin Wall Tube Sample

SYMBOL

LABORATORY TEST SYMBOLS

DEFINITION

W	Moisture content - percent of dry weight
D	Dry density - pounds per cubic foot
LL, PL	Liquid and plastic limits determined in accordance with ASTM D 423 and D 424
Cu	Unconfined compressive strength - pounds per square foot in accordance with ASTM D 2186-66

Additional insertions in Cu column

Pq	Penetrometer reading - tone/square foot
Ts	Torrens reading - tone/square foot
G	Specific gravity - ASTM D 854-58
SL	Shrinkage limit - ASTM D 427-61
pH	Hydrogen ion content - meter method
O	Organic content - combustion method
M.A.*	Grain size analysis
C*	One dimensional consolidation
OC*	Triaxial compression

* See attached data sheet and/or graph

WATER LEVEL

SYMBOL - 

Water levels shown on the boring logs are the levels measured in the borings at the time and under the conditions indicated. In sand, the indicated levels can be considered reliable ground water levels. In clay soil, it is not possible to determine the ground water level within the normal scope of a test boring investigation, except where lenses or layers of more pervious waterbearing soil are present and then a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level symbol for cohesive or mixed texture soils may not indicate the true level of the ground water table. The available water level information is given at the bottom of the log sheet.

DESCRIPTIVE TERMINOLOGY

DENSITY		CONSISTENCY	
TERM	"N" VALUE	TERM	"N" VALUE
Very loose	0-4	Soft	0-4
Loose	5-8	Medium	5-8
Medium Dense	9-15	Rather Stiff	9-15
Dense	16-30	Stiff	16-30
Very Dense	Over 30	Very Stiff	Over 30

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch OD split spoon.

RELATIVE PROPORTIONS

TERM	RANGE
Trace	0-5%
A Little	5-15%
Some	15-30%
With	30-50%

PARTICLE SIZES

Boulders	Over 3"
Gravel	
Coarse	3/4" - 3"
Fine	3/4" - 1/4"
Sand	
Coarse	#4 - #10
Medium	#10 - #40
Fine	#40 - #200
Silt and Clay	Determined by plasticity Characteristics

Note: Sieve sizes shown are U.S. Standard

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CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487 - 69 AND D 2488 - 69

(Unified Soil Classification System)

Major divisions			Group symbols	Typical names	Classification criteria		
Coarse-grained soils More than 50% retained on No. 200 sieve*	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines Less than 5% pass No. 200 sieve GW, GP, SW, SP More than 12% pass No. 200 sieve GM, GC, SM, SC 5 to 12% pass No. 200 sieve <i>Borderline</i> classifications requiring use of dual symbols	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW	
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are <i>borderline</i> classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW	
		Sands with fines	SM	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are <i>borderline</i> classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Fine-grained soils 50% or more passes No. 200 sieve*	Silt and clays Liquid limit 50% or less	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands		Plasticity Chart For classification of fine-grained soils and fine fraction of coarse-grained soils. Atterberg Limits plotting in hatched area are <i>borderline</i> classifications requiring use of dual symbols. Equation of A-line: $PI = 0.73 (LL - 20)$ Liquid Limit	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
OL			Organic silts and organic silty clays of low plasticity				
Silt and clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts				
		CH	Inorganic clays of high plasticity, fat clays				
		OH	Organic clays of medium to high plasticity				
Highly organic soils		Pt	Peat, muck and other highly organic soils				

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*Based on the material passing the 3 in. (76 mm) sieve.

*Based on the material passing the 3 in. (76 mm) sieve.

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HICKOK REPORT
Boring Nos. 4,6,7

910

SL-5

SL-4

SL-6

SL-7

900

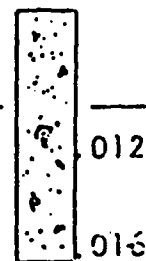
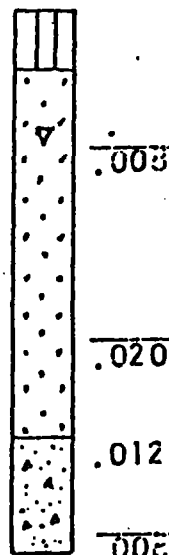
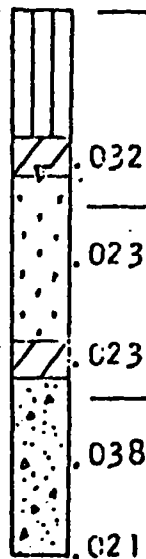
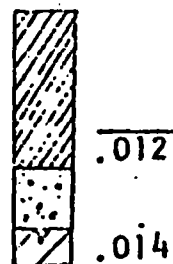
890

880

870

860

1000349



Clay, black, organic



Sand, gravelly



Sand, coarse



Sand, gravelly



Clay, black, organic



Silt



Fill, clean

.008 Phenol concentrations ppm

CITY OF ST. LOUIS, MISSOURI

LABORATORY OF SOIL SCIENCE
ST. LOUIS, MISSOURIL. A. HICKOK & ASSOCIATES
HYDROLOGISTS - ENGINEERS
PLANNING - DESIGN - CONSTRUCTION

JORDAN FORMATION

The Jordan formation is a loosely cemented medium to coarse grained, white sandstone. Average thickness in the St. Louis Park area is 80 - 100 ft. The coarseness of grain and uniformity of grain size make the Jordan formation an excellent aquifer.

To some extent the horizontal migration of phenols in the Jordan resembles that in the St. Peter geologic formation. Phenol concentrations decrease with distance from the source and also up gradient. The high phenol content of municipal well No. 6 is believed due to its location with reference to the low lying land surrounding Minnehaha Creek. Surface water containing phenolic compounds draining from the vicinity of Highway 7 toward Minnehaha Creek could have caused a source of phenols to be located near well No. 6. Therefore, subsurface travel time has been decreased and the phenol concentrations observed are higher than would otherwise be anticipated.

The general pattern of vertical and horizontal migration of phenol compounds is complicated by the existence of numerous fissures and solution cavities in the Shakopee formation overlying the Jordan Sandstone. Numerous wells which penetrate the geologic formations above the Jordan, including the Shakopee formation, if improperly constructed could serve as conduits for vertical migration of phenols.

Evidence of contamination at depth is shown in the area near 29th Street and Idaho Avenue. In this area the results indicate that the St. Peter and Jordan formations contain concentrations of phenols in near equal amounts.

HINCKLEY FORMATION

The Hinckley formation is a coarse to fine, yellowish to pink sandstone. Average thickness in the St. Louis Park area is 120 ft.

A trace of phenols was found to be present in municipal well No. 11 which penetrates the Hinckley formation. Due to location, less than 100 ft. from municipal wells 1, 2, and 3 which are open to the St. Peter formation, it is believed that leakage could be responsible for the presence of this trace of phenols. A sample from well No. 12 also contained a trace of phenols. Municipal well No. 6 located 200 ft. distant, may be responsible for the phenol due to vertical leakage.

It is recommended that further investigations be made to determine the source of these phenols.

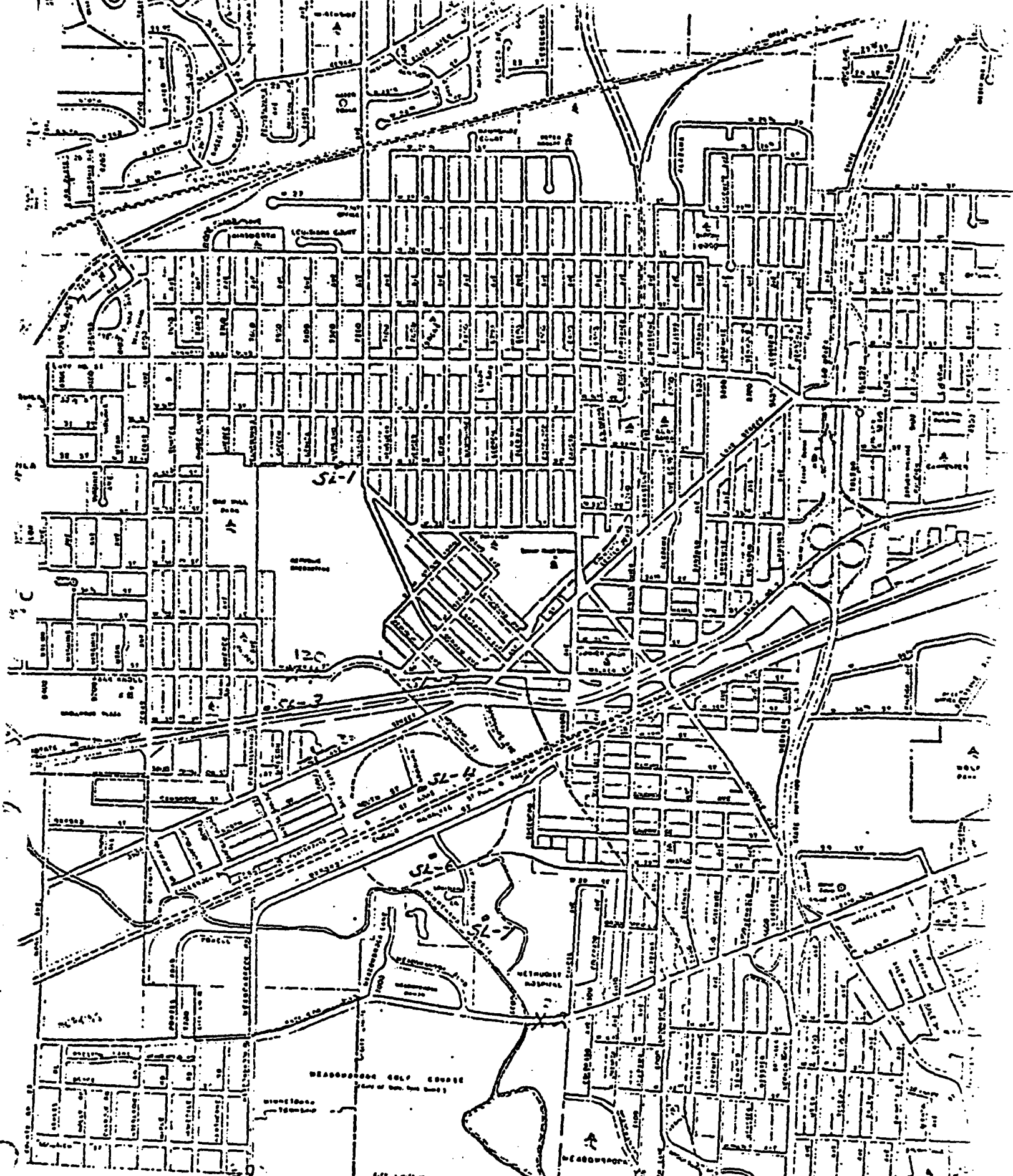
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CONCLUSIONS

1. The chemical process wastes such as those discharged by the Republic Creosoting Company contain phenols.
2. Phenolic compounds have penetrated to the glacial drift, St. Peter, Shakopee and Jordan geologic formations in the vicinity of St. Louis Park.
3. The city wells sampled have phenol concentrations above the upper limits set by the U.S. Public Health Service. Ground water contaminated by phenolic compounds is objectionable and potentially a health hazard. Concentrations of phenol in excess of 0.001 mg/l can be undesirable to the taste and may be harmful to health. (Anon., "Drinking Water Standards," Title 42 - Public Health; Chapt. 1 - Public Health Service, Department of Health, Education and Welfare, Part 72 - Interstate Quarantine Federal Register 2152 (March 6, 1962).
4. Phenols have been identified in municipal and commercial wells at distances of 8,000 ft. from the creosote plant.
5. The glacial drift is primarily utilized for domestic wells in the St. Louis Park area. The majority of the shallow private wells in the glacial drift in the vicinity of the creosote plant have been abandoned.
6. The St. Peter, Jordan and Hinckley formations are the principal aquifers for St. Louis Park municipal and commercial wells.
7. The observed movement of ground water in the vicinity of St. Louis Park is in the same Easterly direction as regional ground-water movement. In some areas the movement is controlled by local pumping wells:

- create*
8. The biodegradation of phenols under anaerobic conditions is not fully understood. Research of public documents to date has not proven helpful in providing an evaluation of analysis techniques or in estimation of the biodegradation features of phenolic compounds.
 9. The ground-water control program initiated should be considered one of continuing investigation. Geologic and hydrologic subsurface information is lacking in many locations in St. Louis Park. This information is needed to document travel of ground-water contaminants.

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X Located at Minnetonka Blvd. & Minnetonka Ave.
 Hopkins Force Main Sample

Figure 1.2 Log of soil borings and phenol
 at various depths.

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Contingent Actions for Contaminated Materials

It is possible that soils contaminated with coal tar materials will be encountered during the drilling of soil borings. It is likely, however, that any contaminated soils will be thoroughly weathered, hence, it is unlikely that volatile or "runny" coal tar wastes or contamination will be encountered.

If any coal tar wastes or contaminated soils are encountered during the drilling of soil borings, the Engineer or his representative will determine if the material is capable of being left at the site based on the following visual determination:

Excavated material containing creosote or coal tar constituents may be used as backfill material if the material is not visually polluted and does not have a noticeable odor of creosote or coal tar.

Material capable of being left at the site will be replaced in approximately its original location and covered with at least twelve inches of clean soil before final grading. Any contaminated soils that are not suitable for backfilling will be stockpiled at a temporary storage facility between West Lake Street and Highway 7 (see Figure I) until all of the work required for the well construction has been completed. The stockpiled material will then be disposed of in accordance with all applicable state and federal regulations at a RCRA hazardous waste treatment/storage/disposal (TSD) facility legally permitted to accept the material and approved by the Environmental Protection Agency and Minnesota Pollution Control Agency. The City will be responsible for said disposal activities.

The temporary storage facility is an area 100 feet by 100 feet surrounded by an eight-foot chain link fence with silt screening at the bottom (see Figure I). The facility is located in a large open field on fill material placed in a bog area that used to receive the wastewater discharge from the former Republic creosoting plant on the Site. The temporary storage facility has adequate capacity to handle the maximum amount of contaminated materials that could be generated during the work described in these project specifications. Any contaminated materials stockpiled in the temporary storage facility will be covered with an impervious barrier and the two gates will be kept locked at all times, except when material is being added to or removed from the stockpile.

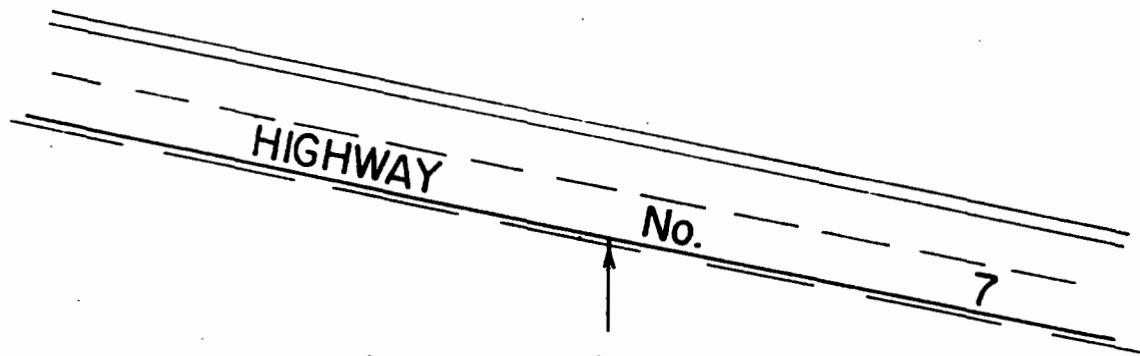
Groundwater and drilling fluids generated during the drilling of soil borings will be classified as contaminated if the water exhibits a discernible oil sheen or oil phase. Contaminated water will be pumped to the sanitary sewer if it contains less than ten percent organic material. Estimates of flow rate, disposal volume and water quality will be established and the Metropolitan Waste Control Commission (MWCC) will be informed before the discharge to the sanitary sewer if the estimated flow exceeds 150 gallons per workday. Contaminated liquids containing more than ten percent organic material or failing to receive MWCC approval for discharge will be disposed of in accordance with all applicable local, state and federal rules and regulations and Part T of the Consent Decree. Uncontaminated water will be disposed of in the storm sewer or by other means acceptable to the City of St. Louis Park.

Any use of the temporary storage facility for contaminated soil boring equipment or materials will be as described above for contaminated soils.

The City will be responsible for keeping the Environmental Protection Agency, Minnesota Pollution Control Agency and Reilly Tar & Chemical Corporation informed of all significant actions involving excavation and disposal of contaminated soils and use of the temporary storage facility. All actions, decisions and communications by the City, Environmental Protection Agency, Minnesota Pollution Control Agency, and Reilly in dealing with contaminated soils will be in accordance with and subject to the provisions of Parts I, J, and O of the Consent Decree in the Reilly settlement.

w/contact

FIGURE 1
TEMPORARY STORAGE FACILITY
FOR
CONTAMINATED MATERIAL



NON-RESPONSIVE